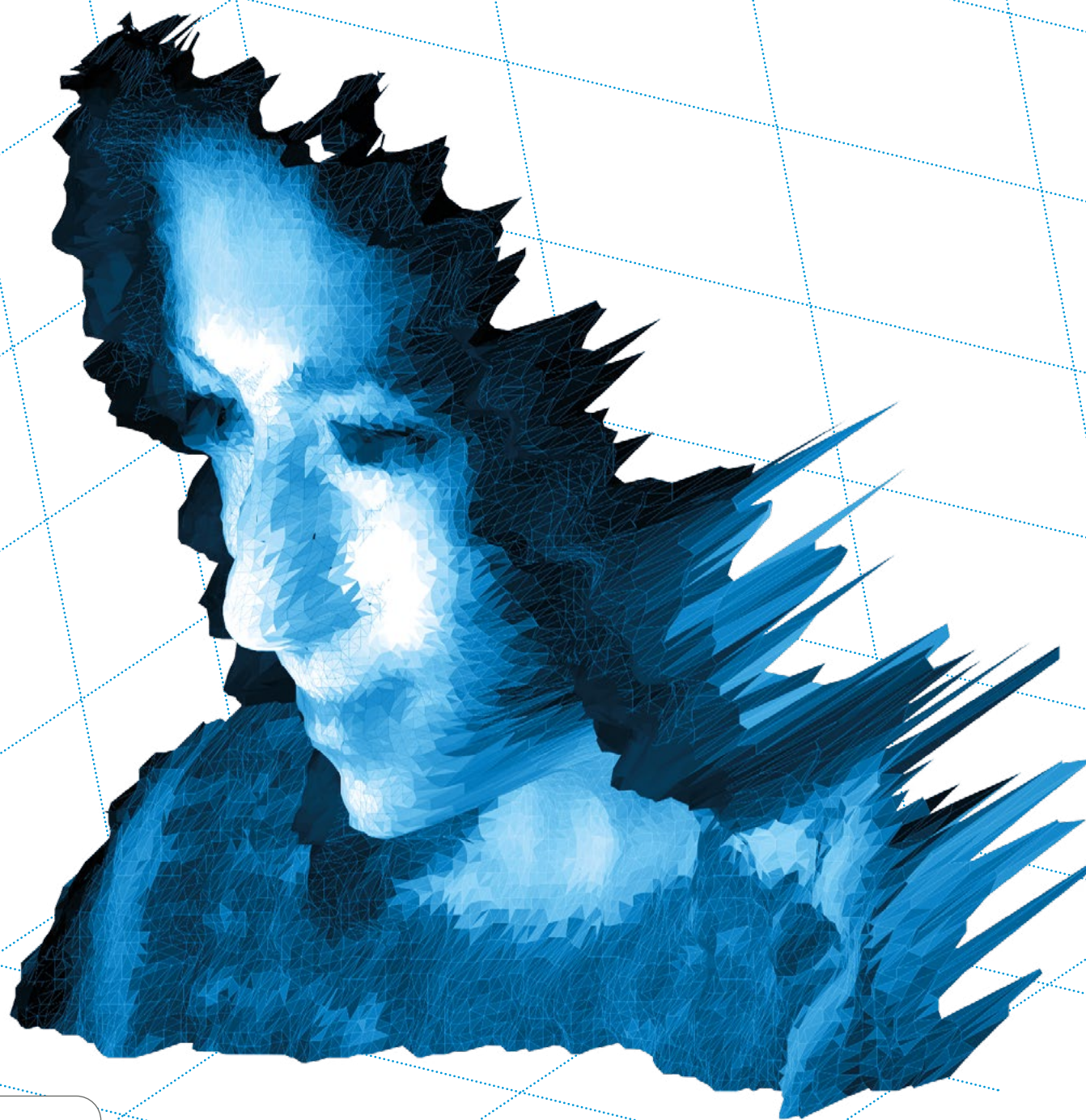


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Annual Report 2014

Interdisciplinary Centre
for Security, Reliability and Trust



Editorial



When academic and industrial research come together, great things happen. The synergy created through public-private research partnerships serves as a breeding ground for new ideas and innovations. Two-way knowledge transfer is an important outcome: it accelerates the innovation process, resulting in competitive high-end systems, services and products that benefit society.

Designing a research policy that creates synergies between public and private research investments is far from trivial. Today, universities and funding agencies are increasingly encouraging focus on academic output at the risk of drowning in bibliometric data. At the other extreme, the EU's Horizon 2020 is devotedly following »innovations« as its saviour, putting long-term research investments at risk. Bridging this gap is a key success factor for any R&D strategy.

At SnT, we work strategically in a continuous effort to interface high-risk, long-term science with goal-oriented research driven by industrial or societal applications. SnT has established an effective model to promote synergy between public and private R&D investment: our Partnership Program. It is demand-driven, goal-oriented and impact-focused. This is the model of the future. It deserves attention and support in the upcoming years – especially in a country such as Luxembourg, where collaboration between academic research and industry is a competitive advantage.

Since 2009, our Partnership Program has grown considerably. We welcomed two

new members in 2014 and two additional partners in 2015, making a total of 24 partners. After all this growth and initiative, we are not resting, but rather looking ahead: our recently founded Tech Transfer Office will take good ideas and prepare them for commercialization. Its experts will provide the know-how to bring results and tech achievements to the market.

And there are more highlights from 2014 I am proud to share: we increased our SnT staff to over 230 people. With Professor Paulo Verissimo, we have the second PEARL chair at SnT, bringing a 5 million Euro grant from the Fonds National de la Recherche. Our continued excellence is seen not only by our partners in industry and the public sector, but also in international agencies such as the European Defence Agency (EDA), who acknowledged our leading role in information and communication technology (ICT) research, granting us the first EDA project in Luxembourg. 2014 marked another successful year and with this momentum we continue to take on new challenges and frontiers to improve security, reliability and trust in ICT in an ever-changing world.

A stylized, handwritten signature in black ink, appearing to read 'Björn Ottersten'.

Prof. Dr. Björn Ottersten
Director



Serious gaming at the museum

When it comes to gaming, Rod McCall means business. For many years, the scientist has tackled the question of how engaging interactive experiences could make a museum visit even more rewarding and informative. To answer this question, McCall and his team are experimenting with an interactive touchscreen table at the Post Museum Luxembourg, which is connected via a video feed with the Post Museum in Athens. The prizewinning European LiveCity project has since evolved into the follow-up project Tel-ME, the Telecom Museum Experience.

At the table, visitors in Luxembourg can play collaborative games relating to the museum collections with visitors in Athens. The driving question for the Luxembourg scientists is: Can collaborative games give the visitors a memorable experience of the museum, from which more information can be more profoundly experienced and understood? And how must the games be designed? After all, the idea is not to have visitors only glued to the touchscreen...

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Marketing good ideas



Professor Ottersten, security in information and communication technology is a topic that is being hotly debated in the public. What's the situation on trust in the security of ICT?

Prof. Dr. Björn Ottersten: The events of recent months certainly haven't helped to boost trust. But it is a good sign that the topic is being publicly debated. That increases awareness for security and trust in ICT – and greater efforts are being made to make software more reliable with respect to security.

You mean, more funding is being provided for ICT research?

Ottersten (laughs): Well, that never goes astray, of course. But money alone won't solve the problem. It has to be viewed in a nuanced light. As two examples: software developers are under pressure to get the program on the market as quickly as possible. Accordingly, it is difficult to always afford security the importance it deserves. To allow higher security standards without slowing down development, you need new technologies for automatically validating the software. That is one approach we are pursuing at SnT.

It is also important to recognise the human as a part of the security system. Hackers frequently use users as a gateway – for example if they don't treat their passwords with care, or if they use memory sticks infected with computer viruses on protected IT systems. Software development must factor in such

behaviour and user needs from the outset. Mistakes happen, and the systems must be able to cope with human error. SnT sees itself as an interface between computer scientists and social scientists – disciplines that both research into the behaviour and lives of people.

Security plays a major role in companies and public authorities. SnT establishes contact with businesses and administrations through its Partnership Programme. Now, you have signed partnership agreements with companies outside Luxembourg. What is your take on that?

I am pleased of course that SnT's reputation as an excellent research institute is spreading beyond the national borders. But we mustn't lose sight of the strategy we are following to create research impact and foster innovations: for one thing, we want to help Luxembourg to become an outstanding location in ICT research. So, for the time being, that means we will be cooperating intensively with local companies and government agencies. That has been a focus of our partnership programme in the past years, and it remains an important focus.

Another thing is that we want to make companies from outside aware of the scientific strength of Luxembourg. We want not only joint research projects; we want companies to perceive Luxembourg as such an attractive location that they will invest in it and even set up research and development branches here. We have already managed that with two new partners.



Prof. Dr. Björn Ottersten

The third component is entrepreneurship. We want the results from our research projects to be commercialized and to actually make their way into real applications.

Isn't that what the companies also want?

In principle, yes, of course. But in the joint partnership projects, good ideas are constantly coming up for new services that aren't in our partners' core business. These ideas should not be lost. So we have now started a tech transfer office at SnT: we want to reduce the initial risk of the projects to make them attractive to investors. And for them to find their way into new business ventures.

How are you approaching that?

The priority in these so-called proof-of-concept projects is not so much the gain in scientific insights but rather the question of validation, securing the intellectual property and, finally, a business plan that allows commercial exploitation. Our newly established Tech

Transfer Office deals with the legal and business aspects. In it, we are gathering the necessary expertise that scientists generally don't have.

This step towards application requires money, which you cannot take out of your research budget.

That's right, so we are closely cooperating with the Fonds National de la Recherche. They provide funding for realising the proof of concept, for example. After that, of course, we have to turn to private investors. We are working on solutions together with our partners to address these aspects.

Do these efforts apply to ICT research alone?

I am convinced we must work through successive steps – proof of concept, securing intellectual property, seed funding – under one roof. But this requires specialist knowledge of the branch: ICT works differently from the life sciences, for example. So our efforts are now

going towards our sector: ICT. We have a mandate within the university to run this pilot project so that our experiences can be propagated to the entire institution. There, we find strong support for our efforts, and we also find interfaces to disciplines other than the computer sciences.

SnT has grown strongly over the years; it has gained many new, high-ranking scientists. Where do you still need reinforcement?

Our strategy follows the ICT sector's needs and demands. A new area that will surely become more important over the next few years is Big Data. How must data be processed in this area so that privacy and security are ensured? What legal principles need to be put into practice? And how can machine learning or data mining improve performance? These are topics that will play an increasingly important role.

Broadening the lines of communication



In the world of satellite communications, certain sets of frequencies are sought more than others for their optimal abilities to transmit data wirelessly and keep up with market traffic demands. Industries compete for these ideal frequencies and the resulting competition creates a scarcity of available channels to send information. Ultimately, this grid-lock limits the industry in an ever-expanding age of big data.

Dr. Symeon Chatzinotas of the SIGCOM team, headed by Prof. Björn Ottersten sees a way to alleviate the congestion caused by companies competing over finite frequencies. The solution?

»Use them flexibly,« he says. »Many of the currently allocated frequencies used for sending data are occupied by different services, but they are actually underutilized and could be used more efficiently by allowing concurrent communication without producing harmful interference.«

The CoRaSat project stands for »Cognitive Radio for Satellite Communications« and aims to demonstrate the viability of using frequencies that are already allocated to other services for broadband satellite communications. In this effort, the group addresses some inherent issues that arise when venturing outside the well-established boundaries of frequency allocation.

The frequencies in question are known as the non-exclusive (shared) Ka-band, a subset used for high-throughput satellite communications. Based on the interme-

diate project results, the Ka-band shows promise of being able to deliver superior performance on the terabyte scale, a potential gain of five times compared to today's standards.

The main concern with these frequencies is ensuring that their usage does not interfere with operations of other ventures. In the case of satellite communications, the CoRaSat group must take into account what is happening on the ground, and more specifically, terrestrial tower communication links used to communicate with one another. Simply put, terrestrial towers are incumbent services, meaning they were established first, and since the rule is »first come first served«, satellite services cannot interfere with their operations.

»The problem is that, in order to use the new system of Ka-band frequencies in satellites, they will have to utilise a wireless channel where terrestrial towers already operate,« says Chatzinotas. »The challenge is to develop technologies so satellite systems can exploit this new band without imposing harmful interference on the existing terrestrial systems.«

According to Dr. Sina Maleki of the CoRaSat project, the solution to the interference problem is to enable flexible frequency usage by designing a database system to monitor and detect when a frequency is in use. The dynamic system would detect and identify a multitude of signal attributes to allow different pairs of satellite-terrestrial links to use the same frequencies while preventing any interference.

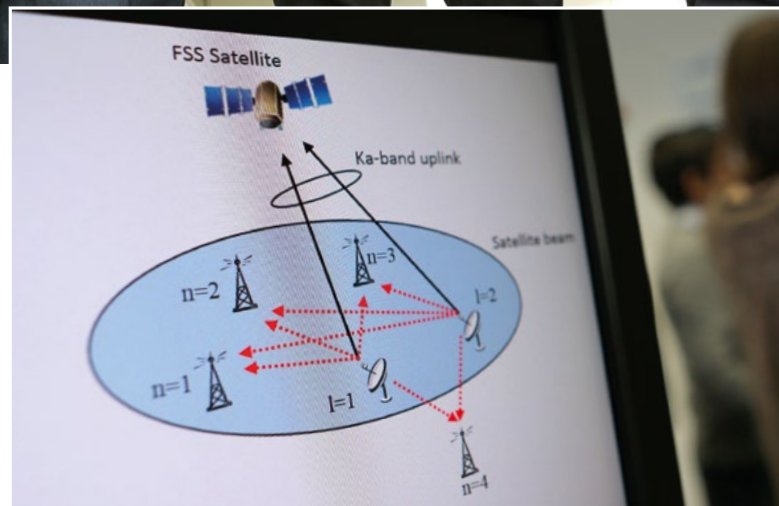


Dr. Symeon Chatzinotas and his team

»So rather than having only one dedicated channel for one transmitter, the dynamic system would allow others to co-exist on an otherwise locked pathway,« says Maleki. »This would reduce airwave congestion and open new business opportunities.«

The research would benefit satellite operators such as SES, a partner of SnT, since they will be able to provide higher quality services while lowering the cost per bit of data sent. Additionally, it would allow SES to satisfy the increasing data rate demands by 2020. The proposed system would also create a whole ecosystem of new payloads and modems, creating business opportunities for satellite and terminal manufactures.

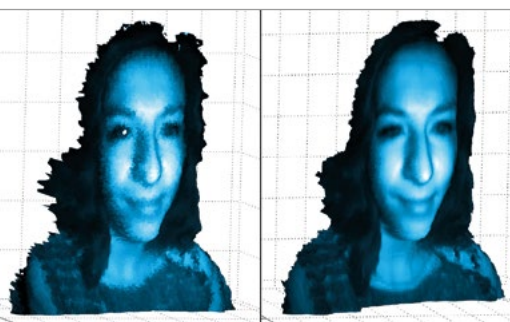
Further, this research provides the necessary roadmap to the communications system operators in order to make



informed decisions about the expected costs and benefits of deploying the proposed Ka-band system. Industry would also benefit from the analysis done by the SIGCOM team in the early stages of the project where they extensively researched the existing standardisations and regulations. The CoRaSat project is the culmination of three years of work, beginning in 2012 and planned for completion in 2015.

»With the successful implementation of the new system, more efficient broadband services can be delivered over the wireless medium. This would be a win-win for both industry and the end user,« says Chatzinotas. »In the end, enabling faster broadband access will allow communication technology to keep up with the ever-increasing demand of a growing world that thrives on free-flowing information.«

Sharp vision in 3D



Please check the video:



When it comes to protecting people and properties, cameras have long been indispensable. They monitor public places and ensure that only authorised people have access to safety-critical areas. Yet, all too often, the pictures taken by surveillance cameras are not good enough to identify burglars or bank robbers – or to apprehend terrorists planning an attack. Recently 3D cameras have emerged in the market providing more robustness to camouflaging and to changes in lighting conditions.

»Unfortunately, to date high resolution is only achievable with expensive high-performance 3D cameras or under constrained settings,« says Dr. Djamila Aouada, who heads the Computer Vision laboratory in the SIGCOM research group of SnT director Prof. Dr. Björn Ottersten. That's why the researchers at the SnT Computer Vision lab are aiming to enable affordable 3D cameras to accomplish a potential comparable to high performance 3D cameras. In different projects with partners from industry such as IEE, a Luxembourg based producer of sensing systems, the SnT Computer Vision team has already made big steps forward.

»Some years ago, we designed a hybrid 2D/3D camera as a platform to fuse a 2D image and a depth image. By doing so, we managed to recover greater details on people and objects in the pictures,« Aouada reports. »Recently, we succeeded in reconstructing 3D images with one low resolution depth camera only,« says Aouada. The SnT Computer Vision researchers achieved this by exploring dynamic information in depth

videos including a series of quickly succeeding images.

The technical hurdles to surmount in this application are enormous, especially the non-rigid deformations of moving objects. But the researchers in Ottersten's team have overcome them with the aid of an innovation they called »non-rigid dynamic super-resolution«. Currently, the team is working on transferring the technology to multi-view systems in which several cameras capture an area from multiple perspectives.

»The feasibility of capturing 3D dynamic scenes containing non-rigid deformations with high quality is important for automatically detecting freely moving objects in videos, e.g. individual humans inside a crowd,« Aouada explains. Another aim are cameras that can recognise people from their faces – for access control purposes, for example. »We are working on algorithms that can tell from facial expressions whether someone is happy, sad, excited or angry,« Aouada says. For one thing, this is important for robots or any interactive machines that will one day work side-by-side with people in workshops, hospitals or the household – with powerful cameras as eyes.

An important aspect for the Luxembourg researchers is protection of privacy. They are accordingly cooperating with cryptography experts as well as legal professionals. Aouada: »We want to ensure the camera data can only be used for the intended purpose and cannot be misused.«



Start-up: Motivation for learner drivers

Mobility has been a central topic at SnT for many years. Raphael Frank and German Castignani have taken up the fight against traffic jams and speeding drivers – so successfully, in fact, that they have now founded their own start-up, called »Motion-S«. At the core of their business is an app – a small program for smartphones – intended to motivate learner drivers to drive more calmly and cautiously.

Three motivating factors apply: control, pleasure and economy. The app collects data about driving habits and makes the driving behaviour a factor in a game in which the driver scores points. There is also financial incentive, where those who drive well and can prove it are rewarded with a reduced premium with Baloise Insurance, a partner in the project.

Data protection and privacy are fundamental to the researchers' app. The insurance company has no access to the original data or motion profiles, but to a rating of the driving behaviour only.

Hackers at the honey pot



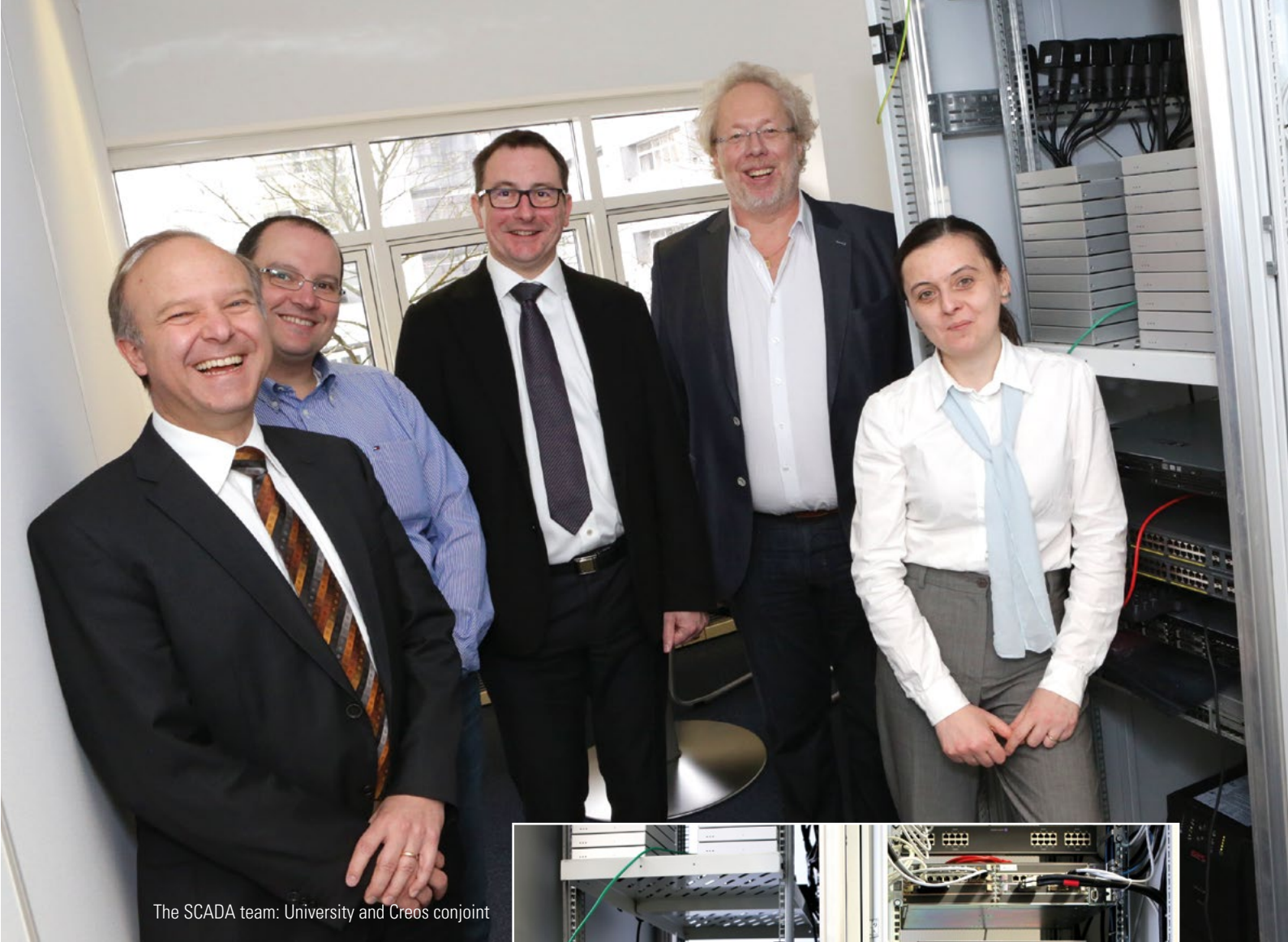
Power plants, factories and public utilities are becoming increasingly frequent targets of cyberattacks. Clever security technologies ought to put a stop to this. When the German Federal Office for Information Security (BSI) published its report at the end of 2014 on the malware attacks recorded over the course of the year, one passage stood out from the rest: the BSI reported an attack on a steelworks that caused a blast furnace to go out of control, causing considerable damage. The attackers had gained access to the production process control through a so-called spear-phishing mail addressed directly to one of the works employees. They then manipulated the plant such that the blast furnace, in which liquid steel as much as 2000 degrees hot was being processed, could no longer be shut down.

Experts like Dr. Radu State, Senior Research Scientist at the Interdisciplinary Center for Security, Reliability and Trust, SnT, are not surprised when such incidents occur. Because they already know: IT infrastructures that control complex processes in production facilities or utilities such as power plants, distributor stations, treatment plants or large factories are becoming ever more popular targets of cyberattacks. The damage the cyber-felons can cause there is enormous. A nightmare scenario author Marc Elsberg described in his 2013 novel »Blackout« – total failure of the power grids across all of Europe as a result of an attack by hackers – reflects the realistic threat very well. As State warns: »Operators of infrastructural facilities therefore need tailored, reliable

security technologies in order to protect their systems against attacks.«

Many people first became aware of the danger to »SCADA« systems – short for Supervisory Control and Data Acquisition systems – through news reports on the »Stuxnet« computer worm. Hackers smuggled this Internet virus into the controllers of various Iranian atomic research facilities in 2010 – and severely disrupted their operation. The researchers at SnT want to find clever solutions to prevent such attacks in future, which could affect public or private establishments in any country.

The challenge: »Most devices built in this domain have to run for 20 to 30 years,« Radu State elaborates – an almost infinitely long time on the timescales of information technology, during which the tools and methods of potential attackers can radically change. »Yet, for most establishments, it is not possible to install so-called patches that could keep the security systems up to date.« The SnT researchers see a way out in security technologies that are highly flexible and at the same time respond in parallel to the threatened process controller – in other words, they guard the plants like a watchdog. For this, the critical data and protecting software are separated from one another. Radu State and Dr. Emilia Tantar in the Netlab research group, headed by Prof. Dr. Thomas Engel, are working out how such a digital watchdog would ideally be structured in a current research project together with Carlo Bartocci and Patrick Colling of the Luxembourg utility company Creos.



The SCADA team: University and Creos conjoint

From disused components once employed in various infrastructural facilities of Creos, the team built a testbed on which to test the responses of various control networks to external attacks. In order to conduct the tests under as realistic conditions as possible, the researchers simply wait for genuine attacks from the Internet. »We have set up a 'honeypot' – a kind of digital dummy that looks like a specific device from outside,« State explains. This attracts cyber villains and tempts them to attack. »This way, we can find out where the attacks come from and what means they use.« The researchers discovered that, in most cases, it was not human hackers, but rather worms or other malware crawling through the Internet. Each time the honeypot is set in place, such digital beasts are not long in coming: »On average, it only takes about five minutes until the first attack is made,« State reports.



In order to analyse the consequences of the attacks and to develop effective countermeasures, he and his team have developed another system, alongside physical components, called »Emulab«. This program was designed in the USA and allows real network components such as routers and servers to be emulated by software. From this, various networks can be created and configured in the computer – and the effectiveness of defence systems played out in a simulated environment.

As a next step, the SnT experts will employ another approach: in an ambitious new project, they want to apply the principle of »software defined networking« onto SCADA control systems. The aim is to allow software to be successively installed on networked devices in future to ensure the setup is permanently protected by the latest technology.

SnT partners



The SnT is a leading international research institute with a strong focus on modern-day information and communication technology (ICT). Together with its partners the Centre is helping establish Luxembourg as a European centre for excellence and innovation in the field of secure, reliable and trustworthy ICT systems and services. Therefore the SnT promotes innovative ideas, increases the depth and breadth of competence and facilitates research in collaboration with partners from industry, the private sector and ICT start-ups. A key role in this process is SnT's Partnership Program. In 2014, two new partners committed themselves to the programme: LuxSpace and neXus.

LuxSpace Sàrl is one of the main actors in Luxembourg's space industry. SnT and LuxSpace have started to cooperate on a joint research programme involving future technologies for micro satellites. The programme initially includes two research projects: the first one is on the



development of an innovative generic and scalable Attitude and Orbit Control System (AOCS). The second one focuses on space debris removal especially in the geostationary orbit and is planned to start at a later stage of the collaboration.

»To establish a partnership with the University of Luxembourg in these research areas will enable us to improve our products in the future and also to offer new services for our customers,« said Jochen Harms, managing director of LuxSpace. »The goal of this joint programme is to further extend the capabilities of micro satellites and hereby creating new business opportunities« he underlines.

»The modelling and control of satellites and space-robots is a major scientific and engineering challenge in automatic control,« says Prof. Holger Voos, programme director, SnT. »LuxSpace is a high-tech, internationally acting company that offers us the rare opportunity

to be involved in the development of space systems. Therefore we really look forward to the coming years of collaboration and common research.«

The Swedish company **neXus** has its field of expertise in computer-based systems for managing the access rights of people and electronic devices – such as laptops and smartphones – to rooms and data, for example in big companies. SnT and neXus will be jointly researching how to unify and simplify such access control systems. Companies and administrations are hard pressed these days to make their IT safer to use mobile electronic devices. Smartphones and laptops are potential carriers of malware. If such a mobile device is connected to a company network, it can inadvertently transmit viruses and cause substantial damage to valuable stocks of data.

»The systems currently used to prevent this can control either the access rights to certain datasets or the physical

access of people and devices to certain buildings or rooms,« Dr. Radu State, scientist and project head, describes the situation: »That means you often need two systems to separately control what device has access to the company network at what location, and what data it is allowed to access.« neXus' aim is to develop with SnT a fundamental concept for a uniform access system. This will make it much easier for companies and authorities to make the right information available to the right people at the right time.

In the scope of its partnership with SnT, neXus will be setting up an R&D division in Luxembourg. »We are delighted to expand our Partnership Program and attract R&D investment to the country,« says SnT director Prof. Dr. Björn Ottersen: »It shows that we have considerably improved the visibility of Luxembourg as a research location in recent years.«

Natural language requirements: making language precise



Natural Language – the language written and spoken by humans – is often imprecise. A car can drive up a road, cruise in a lane, or tear down a street. All of these mean almost the same thing in colloquial speech: a motor-powered vehicle travels along a paved surface. In daily life, these linguistic differences pose little problem. Everyone understands what is meant.

But the vagueness and ambiguity of natural language can create problems in a technical setting such as software development. »To provide satellite services, we develop highly complex software systems that have to work with utmost reliability,« says Frank Zimmer, Senior Manager at SES TechCom, a service company of the satellite operator SES with a vast portfolio of software development in the telecommunications

and space domains. »Before we can design and implement software systems of this sort, we need to describe everything the product will have to do, precisely, in a requirements document. This is done either in cooperation with the customer or by taking high level customer requirements and refining them, such that they fulfil the product specification. Our next task is then to implement the requirements defined in this document – including all the change requests we receive over the course of the project.«

This is where SnT researcher Dr. Mehrdad Sabetzadeh comes in: at the Software Verification and Validation Lab (SVV Lab) headed by Prof. Lionel Briand, Sabetzadeh heads the project »Natural language requirement analysis«. »Customer and system requirements in software projects are usually written up in natural language,« Sabetzadeh explains. »As a consequence, the requirements are prone to the weaknesses of natural language – there may be misleading phrases, undefined terminology, contradictions and ambiguities. This can lead to errors and necessitate a lot of costly rework.«

Detecting vagueness and ambiguity in requirements is a difficult and costly process. »For complex requirements documents that address sophisticated technology, or that are essential for the economic success of a company, you need automated tools that can detect ambiguity and vagueness in a

a requirement for success



Prof. Dr. Lionel Briand and Dr. Mehrdad Sabetzadeh

cost-effective manner and with high reliability,« says Prof. Lionel Briand. »We are tackling this challenge head-on at the SVV Lab in collaboration with SES TechCom.«

»For automated analysis, the text from a requirements document has to be read in and processed by computers,« says Sabetzadeh. For this, the SnT researchers use the so-called Natural Language Processing (NLP) techniques. »These techniques imitate human understanding when processing text,« Sabetzadeh says. Once computers have gone through the requirements and extracted structured information from them, the actual work begins: the algorithms developed by the SVV Lab help engineers more effectively ensure the quality of the requirements.

»For example, one effective way to reduce ambiguity is to identify and define the requirements keywords in a dictionary«, explains Chetan Arora,

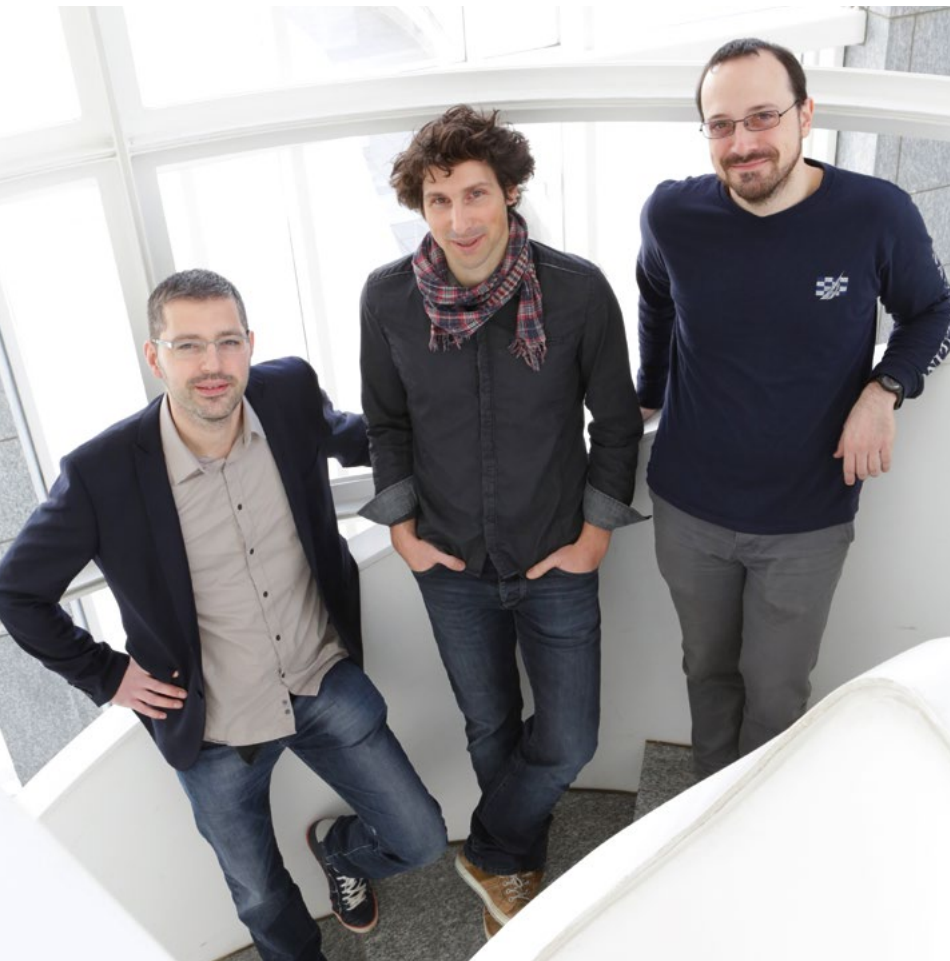
doctoral student at the SVV Lab. »We provide automated assistance to engineers during the construction of such a dictionary«, says Arora. »We have further built tools that keep track of requirements changes and continuously monitor whether changes made in one place will have an effect elsewhere in a requirements document«, he adds.

»Ensuring that the systems we build are fully consistent and meeting our customers' needs are top concerns. The tools developed by the SVV Lab are valuable to us as a way to build further confidence in the quality of our requirements and to identify requirements issues before they have a chance to ripple through the subsequent stages of software development,« says Frank Zimmer of SES TechCom.

Sabetzadeh gives a promising outlook for the research: »Essentially, what we are providing is automation for important requirements quality assurance

activities. Our tools make it possible, among other things, to check the correct application of best writing practices, to identify and group together requirements keywords and to analyse how change propagates in requirements documents. These are time-consuming tasks that requirements analysts have to perform on an ongoing basis. Our tools have commercial potential – the market for them certainly exists.«

Big data and analytics for smart systems



Bits and bytes are governing an increasing number of areas in our lives and businesses. The exploration and simulation of what might happen and what actions can be triggered is a fundamental part of intelligent systems such as smart grids, smart buildings or smart homes. »This is the big challenge of the next decade, which will be driven by data management«, says Prof. Dr. Yves Le Traon, head of the Security Design and Validation Research Group (SerVAL) of SnT.

Beyond collecting and storing a huge amount of data, coming for instance from the envisaged Internet of Things sensors, such systems must autonomously analyse these data in order to make effective decisions in near-real time. In particular, such systems need to understand the variation of data in the past to learn how to adapt and configure the system to the present situation. In this context, the SerVAL researchers propose innovative software solutions for efficiently developing intelligent systems that can leverage big data, databases, machine learning and live analytics to yield tailored and fast smart systems.

As a case example, the scientists working with Le Traon are concentrating on a strategic system for tomorrow's society: a smart grid, which the energy provider Creos is operating as a prototype in Luxembourg. In this smart grid, thousands of sensors – at the power generators and in the electric water and gas meters of the consumers – deliver a continuous flood of data. The



Prof. Dr. Yves Le Traon

researchers are using this to secure the grid against fluctuations and interference. »Our aim is to be able to respond to any external influences with intelligent software, so that the grid does not come out of equilibrium and a blackout is ruled out,« Le Traon says. A sudden increase in power draw or a failure of several wind farms or solar systems due to storms, hail or snow can place enormous strain on the grid. »The system then simulates various possible responses and determines these responses' effects,« the SnT researcher explains.

For this to work, the software must be able to make reliable predictions about the development of the grid – based on the current sensor data and data gathered in the past. »The software learns from these data,« says Le Traon. Researchers Thomas Hartmann, Dr. Francois Fouquet and Dr. Jacques Klein from his team have developed a novel model that mathematically combines the

components of the smart grid together. The insights the scientists gain from the resulting analyses will also be beneficial in smart buildings or production plants in future, Yves Le Traon is convinced.

Besides the power grid, other domains including the automotive and building industries and city organisations can benefit from the new analytics approaches. Smart actions performed by such systems are decided in a predictive or adaptive manner, leveraging all data collected by various sensors. »We intend to have a symbiotic link between the smart system and the user«, Le Traon emphasises. »The smart system is to support the user in order to ease his life, not to control him.« In any case, the human being is still the heart of a smart system.

In most present-day systems, the only intelligence is encoded in static rules. Smart systems, on the other hand, will

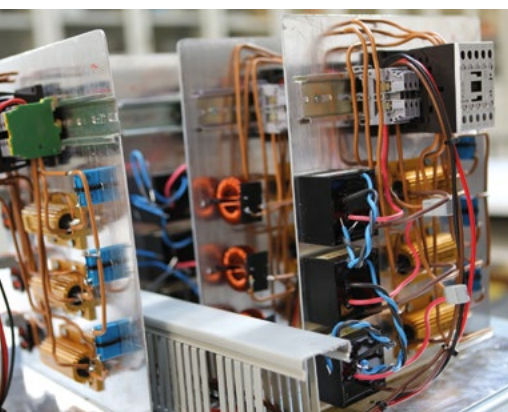
feature recommendation to autonomously predict which actions should be taken before the necessitating event occurs – for example: Shut the air conditioner off if no one will come into the office for the next 20 hours and the temperature will probably be above the threshold when people come in.

»This new intelligence is supported by machine learning algorithms that, based on past data, model the behaviour of the system to predict its evolution,« says Yves Le Traon. In collaboration with POST and Paul Wurth industry partners the SerVAL researchers in his team – Dr. Tegawendé Bissiyandé, Dr. Francois Fouquet, Dr. Cyril Cassagnes, and Dr. Grégory Nain – are building recommendation systems that are scalable and highly accurate for the next generations of smart systems.

Adapting to the grid



Prof. Dr. Jürgen Sachau



The traditional power grid as we know it is changing. With the increase of renewable energy sources like photovoltaics and wind energy, grid engineers are forced to contend with a serious issue not unaccounted for in the grid's initial design – decentralisation.

Surena Neshvad and his Reliable Decentral Energy Systems team, led by Prof. Dr. Jürgen Sachau, have embraced this idea of decentralisation and are taking on the long standing challenge of finding ways to integrate new techs into the grid. Their project, titled »Reliable and Efficient Distributed Electricity Generation in Smart Grids« (REDESG) funded by FNR, seeks to work within the confines of the traditional distribution grid rather than against it. Cities cannot afford the immense costs associated with the direct approach of grid re-design to accommodate more renewables, so changes need to be adapted where possible, and ideally, within the framework of the existing grid. This is why Neshvad and his team are currently focusing on an integral piece of equipment found in modern grid networks, known as relays.

»Relays are responsible for maintaining an orderly flow of electricity in the grid,« says Neshvad. »Their main function is similar to a red traffic light, where it shuts off the flow of electricity if things are overloaded or malfunctioning.«

Renewables present a unique challenge to the grid with intermittent power production and decentralisation, which can have negative effects on grid stability, causing reverse current flows, possibly

damaging components and endangering the workers who maintain the system. But by focusing on improving relays already built-in, the REDESG project group is able to design a model that optimises the relays' ability, making them more dynamic.

The improvements will better adapt to varying power flows brought on by renewables through the use of grid monitoring algorithms which will allow grid operators to have a real-time snapshot of the power flows going across each relay.

»One key aspect to monitoring is to detect what is called a blinding effect,« says Neshvad. »This happens when a relay is unable to detect anomalies in the grid due to inconsistent power flows entering the system and causing the relay to fail, and can lead to unpredictable behaviours like disconnects across portions of the grid.«

The project team is currently in its third year of research, working closely with the SnT partner and local utility provider Creos Luxembourg S.A. to develop the next phase of the project and produce a working small scale model.

Prof. Dr. Paulo Veríssimo

In autumn 2014, Prof. Paulo Veríssimo commenced his research work at the SnT. The renowned computer scientist's interest focuses on so called Critical Information Infrastructures (CII) – systems that are pivotal to reliable operation of the state, society, and the economy. Today's ICT systems are highly interconnected. This complexity offers enormous opportunities, but also creates risks as it may allow malware to infiltrate and escalate. In the worst case, this malware can even damage physical infrastructures, CII's such as power grids and computer systems alike. »Security and dependability of CII's is enormously important in particular to Luxembourg as a location of banking and service industries, as well as being the seat of many European institutions«, says Veríssimo: »The team I am building up at SnT will make a significant contribution to addressing this challenge.«

Veríssimo has been persuaded to move from the University of Lisbon to Luxembourg – thanks not least to the award of a 5 million EUR PEARL Grant from the Fonds National de la Recherche (FNR). Its General Secretary Dr. Marc Schiltz is pleased that the PEARL programme has again proven attractive to an internationally renowned researcher: »Prof. Veríssimo's reputation and the research programme proposed by him convinced us and our Scientific Selection Panel that he should come to Luxembourg.«

See the interview:



Finding trustworthiness



Dr. Gabriele Lenzini

Cheating is an unfortunate reality facing universities and other higher education institutes. For every countermeasure put in place by officials to combat cheating, the ingenuity of the deviant mind seeks a new way to evade honest testing.

Dr. Gabriele Lenzini, Prof. Dr. Peter Y. A. Ryan and Rosario Giustolisi are working to improve how tests are administered, graded and recorded. The goal of the project, called Secure and Verifiable Traditional, Computer-based, and Online Exams (SEVERITAS), is to develop a tool to test the resilience of current exam systems, both pencil-and-paper and electronic, to a variety of frauds on the part of students and authorities. »By taking a systems-based approach to the problem, we are able to chip away at several key vulnerabilities in exams«, says Lenzini.

The chronic problem of dishonesty in exams continues to expand with increases in university attendance and the advent of new types of tests, namely those using computers and the internet. »Getting a trustworthy exam system today is harder because computer and communication technology offers new ways for one to cheat«, says Lenzini. »Luckily, they also offer a way out.«

According to the group, an exam is considered trustworthy when two fundamental qualities are satisfied – security and verifiability. Security refers to the overall protection of information throughout the exam process, and verifiability refers to

the ability to detect whether any tampering happened in the process.

The SEVERITAS team clarifies that an exam is considered secure when the entirety of the process satisfies a series of prompts, including that no student or faculty has prior knowledge of exam questions; only pre-registered students take the exam and all students receive only approved questions with only one submitted exam (no clone exams); no test is modified from the time of submission to notification; the student's anonymity is protected, ensuring fairness in grading; no grades are removed, added or modified and finally, if required, no other students but the intended student will know their grade. »These requirements allow for exam proctors to locate areas of vulnerability«, says Lenzini.

In addition to security, verifiability is a practical way for anyone to challenge the system and confirm that nothing malicious has actually happened, offering an objective way to audit an exam.

The SEVERITAS team analysed a series of existing exam systems through multiple scenarios to determine if they are trustworthy. These scenarios run the gamut of possibilities where cheating could happen, such as dishonest graders or information-sharing students. These scenarios also take into account the effect of honesty in the process by investigating outcomes of well-intentioned participants, where all parties behave »optimally« and follow the rules.



In addition, the team designed its own trustworthy systems. For example, one proposed solution to assure student anonymity is to use what are called »visual-crypto shares«. Students and lecturer are each given a »share«, which look like a black and white checkerboard pattern printed on paper and is mathematically equivalent to a random number chain impossible to guess. At the time of the exam, the student will overlap their share with the lecturer's and reveal a pseudonym which the student can use to conceal their real identity. The system translates easily to electronic formats by using mobile phone devices instead of paper to reveal the pseudonym.

Lenzini notes that the SEVERITAS team's future work will seek to understand ways to detect whether online exams have been shared or copied by developing a method to detect dishonesty by studying patterns of usage.

»The usefulness of our theoretical framework is designed to extend beyond just university exams,« says Lenzini. »Ultimately, this work will expand into other areas where anonymity and trustworthiness are essential, like personnel hiring, project evaluation and scientific paper reviews.«

Simulated cloud



Simulating Energy-Efficient Clouds

In data centres, a lot of energy is lost to side-processes such as data transfer, which is necessary for cloud computing. SnT researcher Dr. Dzmitry Kliazovich has been researching for many years together with his team colleagues and his team leader Prof. Dr. Pascal Bouvry into how the power consumption of cloud computing can be reduced without causing its performance to suffer. As a result they have developed an online tool which tackles the problem.

»We strongly focus our work on the communication within the data networks of a data centre,« says Kliazovich: »The exchange of data between individual computing nodes, routers and memory modules takes not only a lot of time but also copious energy.« In the research project ECO-CLOUD, initiated in May 2013 and continuing until November 2015, the Luxembourg scientists are developing sophisticated technical solutions to solve this problem. Their idea is: the processes and communication networks in a future cloud computing environment ought to organise themselves autonomously so as to run as energy-efficiently as possible.

But how can it be verified whether novel concepts and technologies do in fact bring the hoped benefit? »We – as a central element of the ECO-CLOUD project – have created a simulator with which the effects of various technical solutions on any network structures can be virtually tested,« the SnT researcher announces.

With the cloud computing simulation platform, he and his colleagues can implement ideas of their own on a large scale, test them extensively, vary them and adapt them to the achieved results – just on the computer at the research lab instead of on a real computer farm. All running processes – such as sending, forwarding and possible loss of individual data packets – can be simulated and analysed in detail in a fine-grained model. »An example for a possible application is the optimisation and processing of search inputs at video



Dr. Dzmitry Kliazovich and Prof. Dr. Pascal Bouvry

portals such as YouTube,« Kliazovich explains. While the simulator developed at SnT is not the first to be used to answer such questions virtually, the researcher emphasises, »it is the first, however, that emulates the communication processes in cloud computing to great detail.«

The Luxembourg scientists are not the only ones who can exploit this advantage – the platform is available to the entire research community and to all data centre operators: Kliazovich and his team have placed online »Greencloud«, the »green cloud simulator«: It is accessible to everyone on the website greencloud.gforge.uni.lu. There, the tool can be downloaded for free or used as a virtual machine via the web. »The interest in this is enormous,« Dzmitry Kliazovich is pleased to note. »The page is accessed on average more than 1300

times a month, and the simulator has more than recorded 350 downloads each month.«

With the tool from Luxembourg, users come playfully closer to their aim of bringing power consumption in cloud computing down to the lowest possible minimum. »Research institutes or companies who want to set up a new data centre can thus test, long before commencing the installation, whether they have chosen the most economical strategic approach,« Kliazovich explains. »If not, then the user can test out any number of alternative ideas on the simulator – and keep on refining them until they have achieved the maximum energy efficiency.«

The experts at SnT are meanwhile continually improving the features and usability of Greencloud.

Robots as tour guides



Dr. Patrice Caire and team

In a new exhibition »Eppur Si Muove« at the Luxembourg Museum of Modern Art (MUDAM), visitors will soon be welcomed in an unusual fashion: by robots from SnT.

The MUDAM is the biggest museum in Luxembourg. It is situated in proximity to various establishments of the EU and the nearby campus of the University of Luxembourg. Starting in July, when Luxembourg assumes the presidency of the EU Council, a large exhibition on the history of technology will simultaneously open at the Museum of Modern Art. The SnT of the University of Luxembourg along with its partner Ville de Luxembourg will be key players. The basis for this cooperation was laid in 2014.

»We have developed a new system for this exhibition, and set up an interdisciplinary team of experts, from sciences, to film, sound, museology, etc.« says Dr. Patrice Caire, scientist in the Automation Research Group of Prof. Holger Voos.

»In an all-connected global world, interdisciplinarity is the key to innovation. Our goal is to initiate new concepts to welcome, inform and guide visitors.« Robots will be important actors.

The idea behind the »CoRobots@MUDAM« project is that robots cooperate to receive museum visitors. Humanoid robots, thanks to expert programmers such as Maciej Zurad, will speak to visitors, ask them how they feel, what they

are interested in, introduce themselves amiably, and explain the museum and the exhibitions. »We want to get a dialogue started between robots and museum visitors,« Caire explains. For this, the researchers equipped the mechanical companions with personalities.

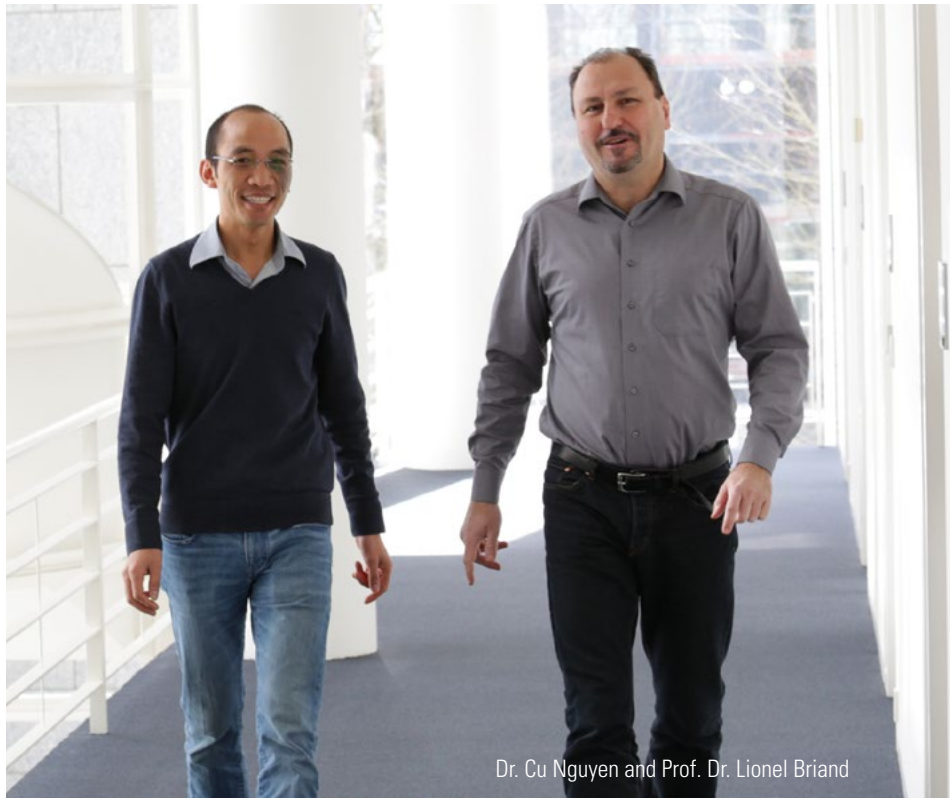
Julie and Tom, the robots, who are to start working as guides, were developed by Patrice Caire and Dr. Miguel Olivares-Mendez. »This research is an important step forward, which goes far beyond the use of robots as mechanical tour guides,« states Caire: humanoid robots for example, will one day also serve as personal assistants for elderly or sick people. Applications such as their appearance as tour guides at the museum serve as valuable scientific trials on the one hand, and on the other hand, as a way to test new technologies for human-machine interaction and study people's acceptance of assistant robots.

The long-term cooperation with the MUDAM, which the City of Luxembourg is supporting, will also bring other mechanical supporters into the museum. In the future, the SnT researchers want to employ other various kinds of robots both to guide the museum visitors through the exhibition rooms and to lead them directly to specific exhibits. At the SnT laboratories Caire's colleague Miguel Olivares-Mendez and Voos' doctoral students Arun Annaiyan and Jan Dentler have already developed drive, control and navigation of the autonomous drones, to be swarming through the MUDAM very soon.

Automation is the key in security testing

As the world is increasingly connected, accessing and sharing data has never been easier. At the same time, security concerns are becoming increasingly acute for corporations as well as for individuals. »Thus, building security into software systems is crucial, and security testing is an important method to achieve that«, says Dr. Cu Duy Nguyen, researcher in SnT's Software Verification and Validation (SSV) Lab which is led by Prof. Lionel Briand. However, such testing is expensive as it is mostly manual and requires testers with advanced skills and knowledge about security tools and potential risks. »Furthermore, the surface that systems expose to the outside world through services and interfaces can be very large, and the variants and types of potential attacks are also numerous«, adds Nguyen: »Manual testing does not scale well to deal with such issues.«

That's the reason why Nguyen works on methods and tools for security testing in the SVV Lab. Relying on the recent advances in machine learning, model-based software testing, and security, Nguyen's work aims at bringing automation in security testing: »We want to automate tedious and complex tasks, such as analysing and monitoring test targets or generating tests with high vulnerability-revealing power«, he says. »Based on state-of-the-art security tools, we have developed algorithms that, based on the responses the systems under test exhibit, automatically learn to generate increasingly effective attacks. As a result, in a fully automated manner, we become more effective at revealing security vulnerabilities over time.«



Dr. Cu Nguyen and Prof. Dr. Lionel Briand

»Like many other web services handling sensitive data, financial and crisis management systems – like those being developed and used by our industry partners, CETREL and HITEC – are notorious for being security sensitive«, explains Lionel Briand: »Our fruitful collaboration with our partners' software engineers is a great opportunity to make significant progress on the front of automated and cost-effective security testing.« This point of view is shared by Benjamin Hourte, head of the software division at HITEC: »Thanks to the automated testing approaches which evolve from our cooperation with SnT, HITEC's software developers can now focus on improving software quality and fixing vulnerabilities. This improves the efficiency of our work tremendously.«

DIABOB – Teaching the artificial pancreas more advanced calculations



It is a dream many diabetics share: a device that autonomously monitors their blood sugar level and automatically administers the right dose of insulin. The first variants of a so-called »artificial pancreas« are already undergoing clinical trial, yet a number of problems are still holding back the real breakthrough in these devices. At SnT's Automation Research Group headed by Prof. Dr. Holger Voos, Adriana Aguilera González and colleagues are researching to improve the technology. In the scope of the DIABOB project, they are working on developing a mathematical model that better represents the metabolic processes in the bodies of type-1 diabetic patients – and which could thus form the basis for an artificial pancreas.

An artificial pancreas – known in the field as a closed-loop system – comprises a sensor that regularly measures the concentration of glucose in the subcutaneous connective tissue. The sensor data are sent to a computer, which controls the insulin dosage via a pump. The device thus imitates the beta cells in the pancreas, which become functionally impaired or even destroyed in type-1 diabetics due to an autoimmune response.

The central control point of such an automated system is the algorithm used to calculate how much insulin the body needs based on the currently measured glucose levels. It may sound easy, but it is highly complicated in practice. One of the main obstacles to developing a

closed loop is the delay in the glucose-insulin interaction.

»The sensor measures the glucose level in the tissue. The algorithm must factor in how this level correlates with the blood glucose level,« Aguilera González explains one of the existing difficulties. It must also be considered that the insulin is dosed not into the blood, but into the tissue. Its action is therefore delayed.

Furthermore, the body's glucose levels fluctuate wildly: eating, sports and other physical activities, and even mood, greatly determine the blood sugar level and lead to major fluctuations over the course of the day. Diabetics account for these effects when they administer their insulin, injecting more insulin before a meal, for example. An automated system cannot do that. After all, it cannot predict how much a diabetic will eat in the next hour, or how much he will exert himself during exercise.

That is exactly what Aguilera González and fellow researchers want to change: »Our algorithm shall factor in the effects of such input variables,« Adriana Aguilera González explains. »It could be used to give approximations of how the glucose-insulin system would react in a given situation, say in the course of a meal.«

For this, the SnT scientists are refining an algorithm that mathematically describes the glucose-insulin system, and which



Dr. Adriana Aguilera González and Prof. Dr. Holger Voos



was already developed more than 30 years ago: the Minimal Model. In this model, the researchers have integrated a so-called unknown input observer. This allows unknown input variables, such as duration or amount of meals, to be accounted for when calculating the metabolic effects. The only measurable input variable of this algorithm is the glucose level in the tissue.

»We are currently testing our algorithm on a virtual diabetes patient,« Aguilera González reports. This simulator has a store of data on various model patients, for example an adult, a child or an adolescent. »The in silico simulations are used for first evaluations of the proposed

model's effectiveness, considering variations in quantity of meals and in insulin type supplied.«

In a second step, real-patient data will be fed in to further validate the proposed model. In collaboration with Jochen Schneider of the LCSB Medical Translational Research Group, cooperation has already begun with the Centre Hospitalier du Nord (CHDN) in Ettelbruck and other clinics.

The DIABOB project runs until 2016. If everything goes well, the researchers will likely be a good deal closer to developing an artificial pancreas by then.

Events



Distinguished Lectures at SnT

Prof. Ralph Schroeder (Oxford Internet Institute): Big Data, Big Brother, and Social Science, February 2014

Prof. Mauro Pezzè (University of Lugano): Exploiting intrinsic redundancy to increase software reliability, May 2014

Prof. Paolo Tonella (Fondazione Bruno Kessler): Model-based Testing in the Era of Web 2.0, June 2014

Prof. Christoph Weidenbach (Max Planck Institute for Informatics): Automated Debugging: Are We There Yet?, June 2014

Prof. Carlo Ghezzi (Politecnico di Milano): Building dependable situation-aware software: how to self-adapt to environment changes, October 2014

Inaugural lecture of **Prof. Paulo Esteves Veríssimo**, October 2014



Workshops and Summer Schools

Engineering Complex Software Systems: Challenges, Solutions and Outlook by Prof. Lionel Briand, January 2014

Data Protection challenges in an Interconnected World by Prof. Mark D. Cole, January 2014

International Workshop on Graphical Models for Security (GraMSec) by Prof. Sjouke Mauw, April 2014

3rd Luxembourg Workshop on Satellite Communication by Prof. Mahulena Hofmann, June 2014

FREESIC Final Field Demonstration by Aurel Machalek, June 2014

Summer School 2014 on Verification Technology Systems & Applications, Luxembourg, October 2014

Conferences

SnT Partnership Day, May 2014

5th European Summit on the Future Internet, June 2014

3rd IEEE International Conference on Cloud Networking by Prof. Pascal Bouvry / Dr. Dzmitry Kliazovich, October 2014

16th International Conference on Formal Engineering Methods by Prof. Sjouke Mauw / Dr. Jun Pang, November 2014



Here comes the sun

2014 was the year of the Net Power Lab at SnT. Even before its official inauguration on 3rd April, Jürgen Sachau and fellow scientists began installing transformers, substations, and power cables as thick as an arm. With their test facilities, they can simulate complex power grids and gather insights that could be of immense value when modernising power grids.

The team is pursuing one goal: to integrate renewable energy sources optimally into complex power grids and to allow the transition from just a few large energy sources, such as nuclear power plants, to many distributed, lower-powered electricity producers, such as photovoltaic systems integrated in buildings. Unsurprisingly, this is no easy task. Which makes it all the more important for researchers to develop sustainable concepts, including hardware and software, to make this transition to »modern power« possible. Three aspects are of primary importance here, underscoring SnT's perfect positioning for such research: Security, Reliability and Trust.

Organisation

Governance of SnT

A Centre Advisory Board, chaired by the President of the University of Luxembourg, advises the President on the Centre's activities (strategy, annual plan, budget, monitoring, review, etc.).

A Scientific Advisory Board reviews the Centre's activities and provides input and recommendations on future activities. The Director is appointed by the University's Board of Governors and is responsible for day-to-day management.

Management Team

Centre Advisory Board

Rainer Klump
President University of Luxembourg, chair

Franck Leprévost
Vice-President University of Luxembourg

Martin Halliwell
CTO SES S.A.

Jean-Marie Spaus
Director POST Telecom

Jean-Paul Zens
Premier Conseiller de Gouvernement, SMC

Aloyse Schoos
CTO IEE S.A.

SnT management team

Signal Processing and Satellite Communications



Björn Ottersten
SnT Director

NetLab



Thomas Engel
SnT Deputy Director

Software Verification and Validation



Lionel Briand
SnT Vice Director

APSIA – Applied Security and Information Assurance



Peter Ryan

Automation Lab



Holger Voos

CritiX



Paulo Esteves Veríssimo

Reliable Decentral Energy Systems



Jürgen Sachau

SerVAL – Security Design and Validation



Yves Le Traon

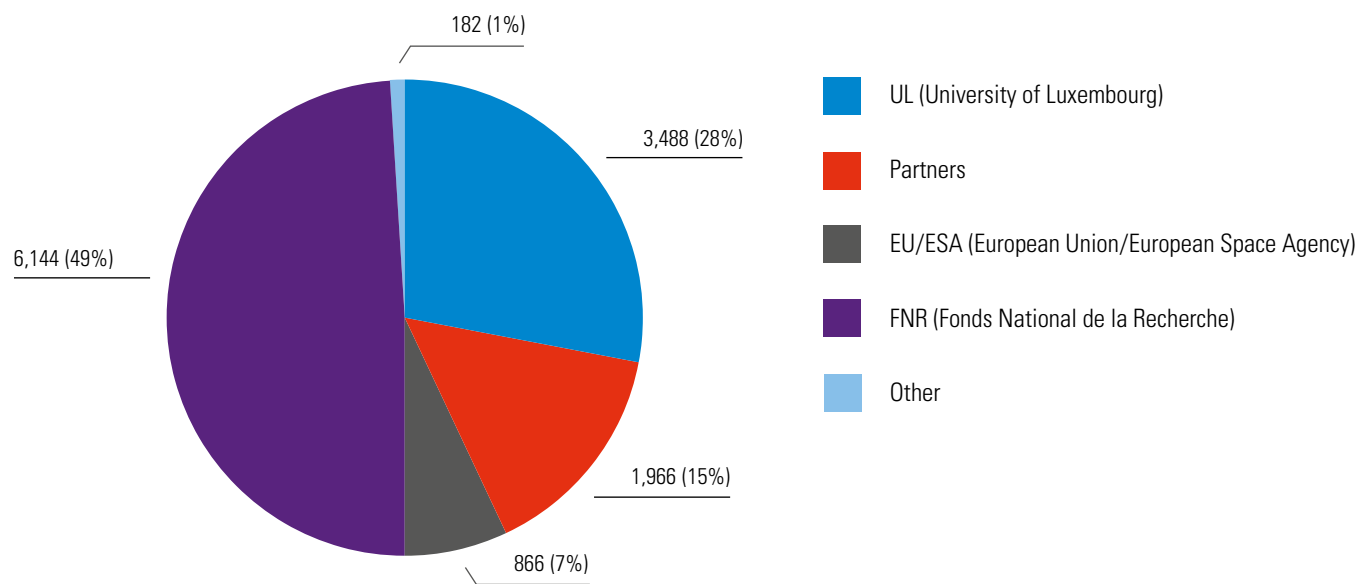
Head of SnT Office Financial Controller



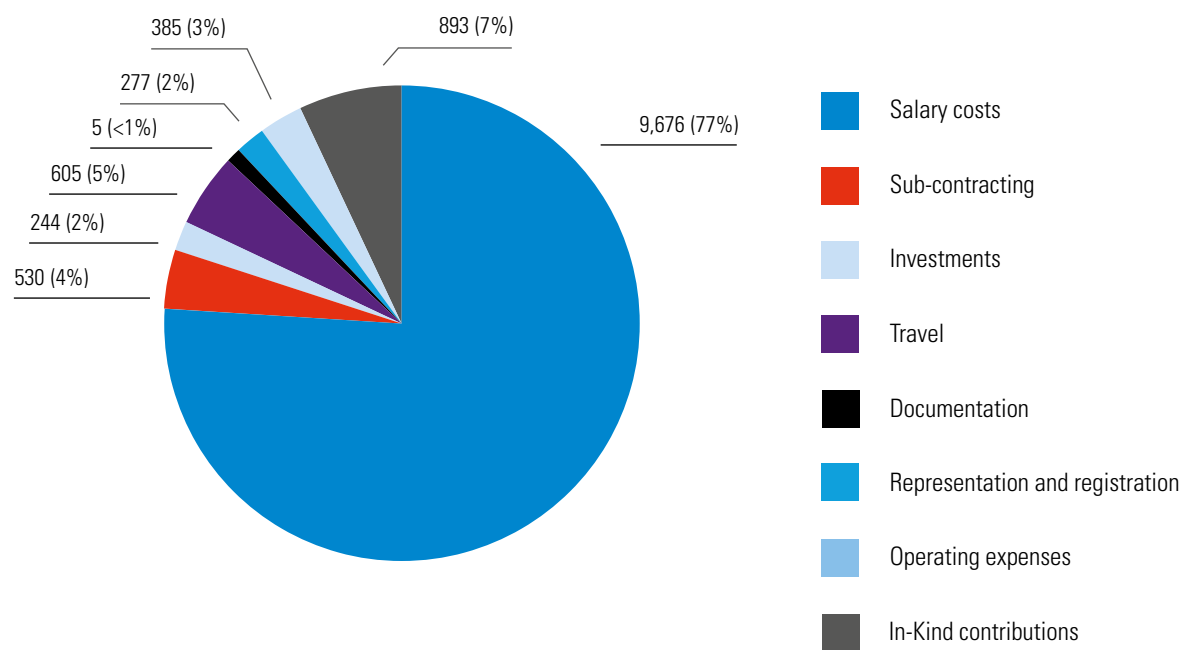
Laurent Betry

Financial data

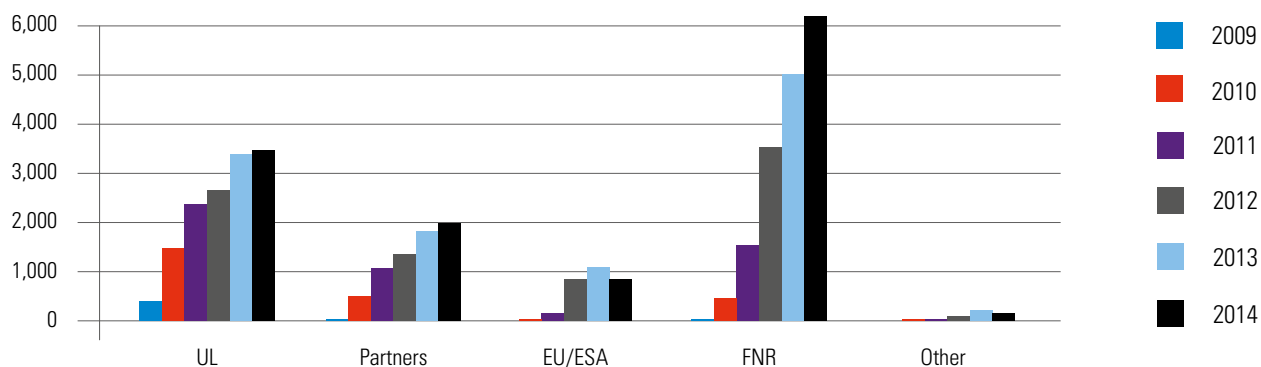
2014 SnT consumed income (in kEUR)



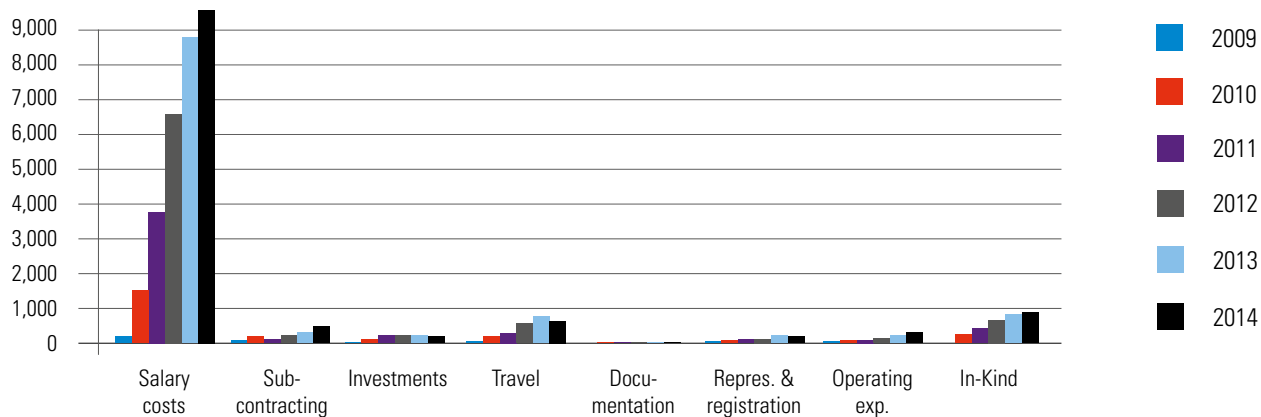
2014 SnT expenses (in kEUR)



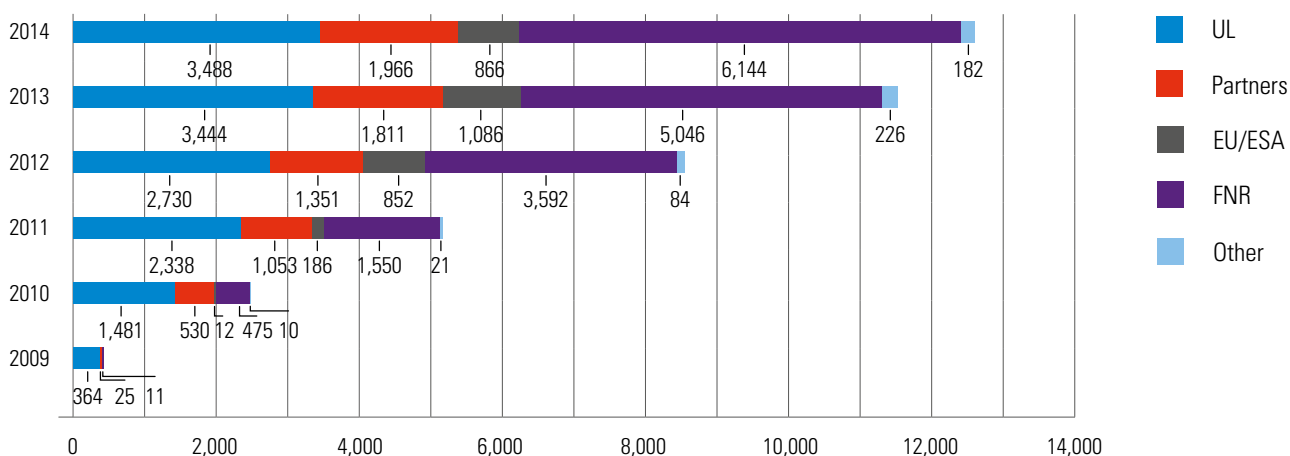
SnT 2009-2014 consumed income per source (in kEUR)



SnT 2009-2014 expenses per category (in kEUR)



SnT 2009-2014 expenses per funding source (in kEUR)



People

Faculty

Heads of SnT research groups

- OTTERSTEN, Björn, Prof. Dr., Director
- ENGEL, Thomas, Prof. Dr., Deputy Director
- BRIAND, Lionel, Prof. Dr., Vice Director
- LE TRAON, Yves, Prof. Dr.
- RYAN, Peter, Prof. Dr.
- SACHAU, Jürgen, Prof. Dr.
- VERÍSSIMO, Paulo, Prof. Dr.
- VOOS, Holger, Prof. Dr.

Affiliated Faculty

- BIRYUKOV, Alex, Prof. Dr.
- BOUVRY, Pascal, Prof. Dr.
- COLE, Mark, Prof. Dr.
- HILGER, Jean, Honorary Prof. Dr.
- HOFMANN, Mahulena, Prof. Dr.
- KELSEN, Pierre, Prof. Dr.
- LEPREVOST, Franck, Prof. Dr.
- MARTIN, Romain, Prof. Dr.
- MAUW, Sjouke, Prof. Dr.
- MAX, Charles, Prof. Dr.
- VAN DER TORRE, Leon, Prof. Dr.
- VITI, Francesco, Prof. Dr.

Senior Research Scientists

- LENZINI, Gabriele, Dr.
- STATE, Radu, Dr.

Research Scientists

- AOUADA, Djamilia, Dr.
- CHATZINOTAS, Symeon, Dr.
- FRANK, Raphaël, Dr.
- KLEIN, Jacques, Dr.
- KOENIG, Vincent, Dr.
- MYSORE, R. R. Bhavani Shankar, Dr.
- NEJATI, Shiva, Dr.
- SABETZADEH, Mehrdad, Dr.
- PANG, Jun, Dr.

Research Associates

- ADEDJOUMA, Morayo, Dr. (up to 14/05/2014)
- AGUILERA GONZÁLEZ, Adriana, Dr.
- ARLT, Stephan, Dr.
- AVANESOV, Tigran, Dr.
- BARTOLINI, Cesare, Dr.
- BIANCULLI, Domenico, Dr.
- BISSYANDE, Tegawendé, Dr.
- BOOTH, Richard, Dr.
- BRAATZ, Benjamin, Dr.

- CAIRE, Patrice, Dr.
- CAPITANESCU, Florin, Dr.
- CASSAGNES, Cyril, Dr.
- CASTIGNANI, German, Dr.
- CHRISTOPOULOS, Dimitrios, Dr. (from 01/08/2014)
- CRAMER, Marcos, Dr.
- CUNHA DE ALMEIDA, Edouardo, Dr.
- DERBEZ, Patrick, Dr.
- DORRONSORO, Bernabé, Dr.
- EMERAS, Joseph, Dr.
- FAYE, Sébastien, Dr.
- FERREIRA, Ana, Dr.
- FOUQUET, François, Dr.
- FOURNERET, Elizabeta, Dr.
- FRANCOIS, Jérôme, Dr. (up to 28/02/2014)
- GADYATSKAYA, Olga, Dr.
- GARCIA BECERRO, Frederic, Dr.
- GERARD, Benjamin, Dr.
- GHEORGHE, Gabriela, Dr.
- GIURGIU, Andra, Dr.
- GOKNIL, Arda, Dr.
- GONCALVES ALMEIDA ANTUNES, Michel, Dr.
- HACK, Nathalie
- HERMANN, Frank, Dr.
- IOVINO, Vincenzo, Dr.
- JHAWAR, Ravi, Dr.
- JOAQUIM, Rui, Dr.
- JOSTOCK, Markus, Dr.
- JUNGSMANN, Manuela, Dr.
- KANNAN, Somasundar, Dr.
- KANTOR, Miroslaw, Dr.
- KHADER, Dalia, Dr.
- KIM, Dongsun, Dr.
- KLIASOVICH, Dzmitry, Dr.
- KORDY, Barbara, Dr.
- LADID, Latif
- LAGUNAS, Eva, Dr.
- LANCRENON, Jean, Dr.
- LI, Yumei, Dr.
- LOUVETON, Nicolas, Dr.
- LUCAS FILHOS, Edson Ramiro, Dr.
- LUCIA, Lucia, Dr.
- MACHALEK, Aurel
- MALEKI, Sina, Dr.
- MAZZALI, Nicolò, Dr.
- McCALL, Roderick, Dr.
- MELAKESSOU, Foued, Dr.
- MOUELHI, Tejeddine, Dr.
- NAIN, Gregory, Dr.

- NDOYE, Ibrahima, Dr.
- NGUYEN, Duy Cu, Dr.
- OLIVARES MENDEZ, Miguel Angel, Dr.
- OUCHANI, Samir, Dr.
- PALATTELLA, Maria Rita, Dr.
- PAN, Lin, Dr.
- PANCHENKO, Andriy, Dr.
- PAPADAKIS, Michail, Dr.
- PASTORE, Fabrizio, Dr.
- POLETEEV, Andrei, Dr.
- RIENSTRA, Tjitze, Dr.
- ROSICH, Albert, Dr.
- SANNIER, Nicolas, Dr.
- SHAR, Lwin Khin, Dr.
- SHARMA, Shree Krishna, Dr. (from 01/11/2014)
- SIRY, Lawrence, Dr.
- SONG, Ju-Youn
- STAATS, Matthew J., Dr.
- TANG, Qiang, Dr.
- TANTAR, Alexandru, Dr.
- TANTAR, Emilia, Dr.
- TRUJILLO RASUA, Rolando, Dr.
- UDOVENKO, Aleksei
- WU, Yining, Dr.
- ZHANG, Qin

PhD Candidates

- ABU SHABAN, Zohair M.
- AFZAL, Hassan
- AL ISMAEIL, Kassem
- ALBANESE, Claudia
- ALLIX, Kevin
- ALODEH, Maha
- AMBROSSIO, Diego Agustin
- ANNAIYAN, Arun
- APPELT, Dennis
- ARORA, Chetan
- BARTEL, Alexandre
- BEN FADHEL, Ameni
- BILIBIN, Ilya
- BLANCA, Philippe
- BRONZI, Walter
- BRÜHL, Manuel
- CHEN, Xihui
- CHENAL, Massimo
- CHRISTOPOULOS, Dimitrios (up to 31/07/2014)
- CODECA, Lara
- COLOMBO TOSATTO, Silvano
- CORREA BAHNSEN, Alejandro

· DELERUE ARRIAGA, Afonso

· DEMISSE, Girum

· DENTLER, Jan

· DERRMANN, Thierry

· DI DONNA, Aniello Simone

· DI NARDO, Daniel

· DINU, Dumitru-Daniel

· DOLBERG, Lautaro

· DOU, Wei

· EL KATEB, Donia

· FALK, Eric

· FELTES, Florian

· FIANDRINO, Claudio

· FORSTER, Markus

· GHARANJIK, Ahmad

· GIESE, Mark Otto

· GIUSTOLISI, Rosario

· GNIEWEK, Alicja

· GOERGEN, David

· GOTTMANN, Susann

· GRZYBEK, Agata

· GUZEK, Mateusz

· HAJRI, Ines

· HAMMERSCHMIDT, Christian

· HARTMANN, Thomas

· HENARD, Christopher

· HOMMES, Stefan

· HUMPREYS, Llio

· HUYNEN, Jean-Louis

· JAN, Sadeeq

· JEROME, Quentin

· JIMENEZ, Matthieu

· KALANTARI, Ashkan

· KALBOUSSI, Sabrina

· KRACHEEL, Martin

· KREUTZ, Diego

· LANZE, Fabian

· LE, Ha Thanh

· LI, Li

· LIU, Bing

· MADDOURI, Sami

· MARCHAL, Samuel

· MARGOSSIAN, Hrag

· MARROUCHE, Wissam

· MARTINEZ PERDIGUERO, Jabier

· MATINNEJAD, Reza

· MEIRA, Jorge

· MENGALI, Alberto

· MOAWAD, Assaad

· MOUTON, Maximilien

· NACHTIGALL, Nico

· NEISIUS, Yves

· NESHVAD, Surena

· NGUYEN, Anh Quan

· NGUYEN, Phu Hong

· NORTA, David

· OUAFO LAMBO, Adrienne

· PEREZ URQUIDI, Miguel José

· PERRIN, Léo Paul

· PIAZZA, Roberto

· PODLASZEWSKI, Mikolaj

· POLITIS, Christos

· ROY, Arnab

· RUBAB, Iram

· SAJADI ALAMDARI, Amin Seyed

· SANCHEZ GUINEA, Alejandro

· SCHMITZ, Sandra

· SCHWICKART, Tim

· SHARMA, Shree Krishna (up to 31/10/2014)

· SIGNORELLO, Salvatore

· SKOUTARIS, Eleftherios

· SKROBOT, Marjan

· SOLTANA, Ghanem

· SPAGNUELO, Dayana

· STATHAKIS, Apostolos

· TABATABAEI, Masoud

· THOME, Julian

· TSAKMALIS, Anestis

· VAN ZEE, Marc

· WANG, Chunhui

· WANG, Jun

· ZIAFATI, Pouyan

Research Fellows

· ADEDJOURA, Morayo (from 01/08/2014)

· ARCURI, Andrea

· CHERKAoui, Omar

· DE WACHTER, Hannes

· FOFI, David

· FRANCOIS, Jérôme, Dr. (from 01/08/2014)

· HELMINGER, Paul

· IQBAL, Muhammad Zohaib

· KENNY, Steve

· KHAN, Muhammad Uzair

· NAVEH, David

· ORMAZABAL, Gaston

· SCHWARZ DA SILVA, João

· SIMON, Carlo

· VON SCHEFFER, Guido

· ZHENG, Gan

Staff

· ANNET, Stéphanie, Communications and Events Assistant

· BETRY, Laurent, Head of Administration and Support/Financial Controller

· CHESNAY, Isabelle, Project Coordinator

· EDWARDSDOTTIR, Helga, Administrative Assistant

· EYJOLFSDOTTIR, Ragga, Administrative Assistant

· FUHRER, Pierre, Project Coordinator

· GALLO, Marie-France, HR Assistant

· GUGAN, Daniel, Project Coordinator

· HANS, Dirk, Communication

· KINET, Christine, Administrative Assistant

· LAGROST, Céline, Project Coordinator

· LAROCHE, Corinne, Administrative Assistant

· MARTIN, Magali, Administrative Assistant

· ÖSTLUND, Stefanie, Project Coordinator

· PETIT, Cécile, Dr., Project Coordinator

· SCHWEITZER, Jean, Dr., Project Development Manager

· THUR, Claudia, Administrative Assistant

Technical Staff

· DARUKA, Christiena

· DUNLOP, Dominic

· KORDY, Piotr

· NEY, Marco

· WEITZ, Hervé

Visitors

· GIORDANO, Francesco, Università degli Studi di Perugia

· ITURRIAGA, Santiago, Universidad de la República, Uruguay

· LÓPEZ LOCÉS, Mario César, Instituto Tecnológico de Ciudad Madero

· SANTOS, Alinne, University of São Paulo

· SOUZA, Francisco Carlos, University of São Paulo

· ZIADI, Tewfik, University of Pierre & Marie Curie, Paris

Awards



The Cedergren Medal

Individual awards

The Swedish government has appointed Prof. Björn Ottersten as a board member of the Swedish Research Council.

Florian Feltes received the St. Gallen Wings of Excellence Award 2014 for his paper »Business between generations - Share economy the death of Taylorism - new leadership strategies will have to be required«. His paper has been ranked among the top 100 submissions and qualified him for participation as a Leader of Tomorrow in the 44th St. Gallen Symposium.

The European LiveCity research project won the award for best project demonstration at the Future Internet Assembly Conference held in Athens, Greece. SnT Researchers Dr. Rod McCall, Dr. Andrei Popleteev and Dr. Tigran Avanesov are contributors to the project. LiveCity was chosen from 48 contenders.

The former project SECRIKOM was selected by the EC as a success story of the SECURITY programme in FP7, due

to a statement of the Slovak SECURITY delegate Prof. Luby. 200 projects in FP7 SECURITY were evaluated among which 15 were selected as success stories and SECRIKOM is one of them.

Prof. Björn Ottersten was awarded the Cedergren Medal by the Board of Governors at KTH – Royal Institute of Technology in Stockholm, Sweden. The first medal of the Cedergren Foundation was handed over in 1914. Now, a century later, Björn Ottersten has received the 12th medal ever. In 1988, the Nobel Prize winner in physics, Hannes Alfvén, was awardee of the medal. Ottersten received the medal at the diploma ceremony in the Stockholm City Hall on 17 December 2014.

Prof. Björn Ottersten, Dr. Symeon Chatzinotas and Dr. Bhavani Shankar have received the award of the Satellite and Space Communications Technical Committee (SSC-TC) for »Distinguished Contributions to Satellite Communications«. It was handed over during IEEE Globecom 2014 at the committee's annual meeting on 12 December 2014. SSC-TC is part of the IEEE Communications Society which promotes the advancement of science, technology and applications in communications and related disciplines.

Best paper awards

»Formal Analysis of Electronic Exams«, Rosario Giustolisi, Dr. Gabriele Lenzini, Prof. Peter Y. A. Ryan, Dr. Jannik Dreier, Ali Kassem, Dr. Pascal Lafourcade, 11th International Conference on Security and Cryptography (SECRYPT 2014), Vienna, Austria

»Observer Design for a Nonlinear Minimal Model of Glucose Disappearance and Insulin Kinetics«, Prof. Holger Voos, Prof. Driss Boutat, Prof. Mohamed Darouach, 8th International Conference on Bio-inspired Systems and Signal Processing (BIOSIGNALS 2014), Angers, France

»Reasoning at Runtime using time-distorted Contexts: A Models@run.time based Approach«, Thomas Hartmann, Francois Fouquet, Dr. Gregory Nain, Dr. Brice Morin, Dr. Jacques Klein, Prof. Yves Le Traon, 26th International Conference on Software Engineering and Knowledge Engineering, Vancouver, Canada

»MiL testing of highly configurable continuous controllers: scalable search using surrogate models«, Reza Matinnejad, Dr. Shiva Nejati, Prof. Lionel Briand, Thomas Bruckmann, 29th IEEE/ACM International Conference on Automated Software Engineering (ASE 2014), Västerås, Sweden

»New Access Control Scheme for Facebook-style Social Networks«, Jun Pang, Yang Zhang, International Conference on Availability, Reliability and Security (ARES 2014), Fribourg, Switzerland

»Collaborative-Relay Beamforming with Perfect CSI: Optimum and Distributed Implementation«, Dr. Gan Zheng, Dr. Kai-Kit Wong, Prof. Björn Ottersten, IEEE Signal Processing Society Best Paper Award

Project flashlights

SerVAL

Head of research group: Prof. Dr. Yves Le Traon

Software product line design and test

Contacts: Dr. Christopher Hénard, Dr. Mike Papadakis, Jabier Martinez

Complex situations and user needs have led to the expansion of Software Product Lines (SPLs). SPLs allow users to configure tailored products. Two key challenges need to be addressed. First, testing SPLs is difficult because of the millions of possible configurations requiring reduction and prioritisation of solutions. With CETREL, the testing of card authorisation systems is optimised by applying techniques to authorisations modelled as an SPL. The second challenge is addressing the magnitude of the possible options available and is tackled with Feature Relations Graphs, a new approach for visualising and understanding SPL configurations.



Machine learning-based malware detector for Android applications

Contacts: Dr. Jacques Klein, Dr. Tegawendé Bissyandé, Kevin Allix

Malware detection is a challenge for mobile computing, where thousands of apps are uploaded daily to app markets for end-users. Market owners, like Google Play, require efficient techniques to analyse and detect malicious apps to keep markets clean, maintaining user confidence. However, using antivirus software on Google datasets reveals that hundreds of suspicious apps often go through undetected. Serval researchers are investigating the effect of ignoring these problem apps and also considering historical coherence in selecting test datasets for malware detection built upon Machine learning techniques.

SIGCOM

Head of research group: Prof. Dr. Björn Ottersten

Constructive interference in 5G cellular systems

Contacts: Dr. Symeon Chatzinotas, Maha Alodeh

Multiuser interference is a harmful factor that degrades the performance of the downlink of multiple-antenna 5G Cellular Systems. The main idea to address this issue is to use adjust aspects like channel condition and user data at the transmitter to control the interference. Utilising such information helps to classify the interference into two types: a constructive and a destructive interference. Constructive interference is useful by nature because it enhances the wireless service. On the other hand, destructive interference requires additional processing to convert it into a useful trait. Therefore, the total interference can be transformed into additional energy sources that can be beneficial instead of harmful.

Multiple carrier predistortion

Contacts: Dr. Bhavani Shankar Rao, Roberto Piazza

To exploit the benefits of multicarrier amplification on satellites, researchers at SnT are investigating the design and implementation of on-ground predistortion techniques. This has been undertaken through four European Space Agency (ESA) projects and in-house research. Researchers at SIGCOM have proposed data predistortion, operating jointly with the signals transmitted over different carriers and providing significant performance gains at lower complexity. Several designs and procedures to identify predistorter parameters have also been devised. This activity has resulted in four journal submissions and a patent filling jointly with SES among others.

Reliable Decentral Energy Systems

Head of research group: Prof. Dr. Jürgen Sachau

Grid identification

Contact: Surena Neshvad

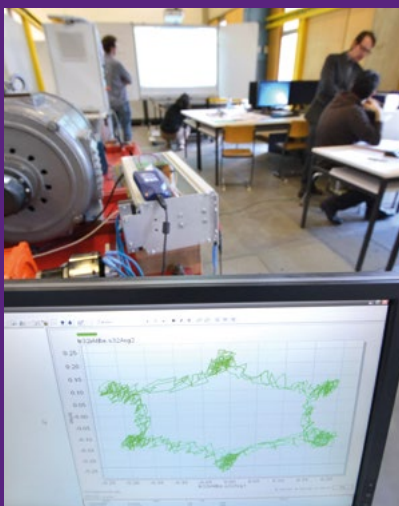
A large number of inverter-based generators have been connected to the power network in recent years. This has significantly complicated powerflows, requiring advanced and intelligent monitoring in order to optimise efficiency and reliability.

This research proposes a method for identifying power system parameters by injecting Pseudo Random Binary Signals through modification of the Pulse Width Modulator of inverter-based distributed generators. The generated broadband signals are measured at various locations in the grid and are correlated in order to obtain a real-time snapshot of the power network's parameters.

Thermoelectricity in the RDES research group

Contact: Mark Otto Giese

Under the supervision of Prof. Jürgen Sachau, the team investigates new scopes of application of thermoelectric generators. One focus is the integration of the latest state of the art devices, which adopt new thermoelectric materials and design concepts. In order to strengthen international relations and encourage a synergistic partnership, a cooperation has been established with the thermoelectric research group from the University of Duisburg-Essen, whose core expertise lies in material research, devices design and material synthesis.



Software Verification and Validation Lab

Head of research group: Prof. Dr. Lionel Briand

Automated testing of data acquisition systems

Contacts: Daniel Di Nardo, Dr. Fabrizio Pastore

Data acquisition software is at the heart of systems used to understand and interact with the real world. Automated testing of such systems is a challenge because of the complexity of the data they process. The team achieves this by innovatively combining data modelling and field data. UML class diagrams are used to capture the structure of inputs and outputs, while model annotations written using UML stereotypes and OCL constraints are used to capture the fault model. The team relies upon field data to generate test inputs by means of data mutation guided by stereotypes and reuse of constraints as automated oracles. Successful results include automated testing with project partner SES.

Automated requirements-based testing for embedded systems

Contacts: Chunhui Wang, Dr. Fabrizio Pastore, Dr. Arda Goknil

Safety critical systems, such as the ones developed by partner organisation IEE, must comply with standards that mandate traceability between requirements and test cases. Software engineers accomplish this by manually deriving test cases from requirements written in natural language. This project has the ambitious goal of automatically generating executable system test cases from use case specifications. The team achieves this through natural language processing and constraint solving techniques that require minimal effort from software engineers. Engineers in fact, are only required to define use cases in a structured format and refine conditions using a constraint language.

CritiX

Head of research group: Prof. Dr. Paulo Veríssimo

Towards secure and dependable software-defined networking (SDN)

Contact: Diego Kreutz

Software Defined Networks will become the basis of any large-scale information infrastructure, including clouds. However, the security and dependability of SDN are still ongoing issues. The goal is to investigate how to build secure and dependable SDNs by focusing on issues affecting the control plane. As a starting point, the team aims to investigate the main issues regarding device management, trust associations and relationships between devices, security mechanisms for the control plane communications and assessing trustworthiness of devices.

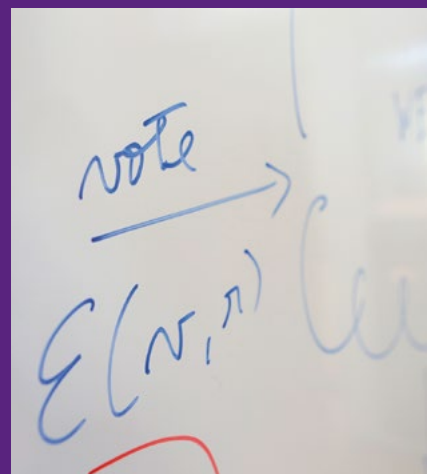
APSIA

Head of research group: Prof. Dr. Peter Ryan

BRAIDS – boosting security and efficiency in recommender systems

Contact: Dr. Qiang Tang

In large-scale data sharing systems, such as recommender systems, there is a well-known issue between the input privacy and the utility. Two approaches exist to resolve this problem. The pure cryptographic approach provides rigorous privacy guarantees, but is prohibitively inefficient, whereas the data obfuscation approach is efficient but it is usually not rigorous and can compromise the utility. In this project, the BRAIDS team is solving the problem through an in-depth fusion of these two approaches. Intuitively, an individual user's inputs are blended into other user's inputs in all computations, using a similar concept of differential privacy but without adding noise. The blending process is ultimately cryptographically secured.



Ensuring fair voting in elections

Contact: Prof. Dr. Peter Ryan

In November 2014, the FNR funded the CORE project SeRTVS, led by Prof. Peter Y. A. Ryan, culminated in the use of a verifiable voting system based on Ryan's Pret a Voter system to elect the Legislative Assembly in Victoria State, Australia. The system was developed for the Victoria Electoral Commission in collaboration with researchers from Surrey University in the UK and Melbourne University. The system performed well and received favourable reviews from voters who used the system.

Automation Research Group

Head of research group: Prof. Dr. Holger Voos

LuxSpace and SnT sign cooperation agreement for joint research

Contact: Dr. Somasundar Kannan

LuxSpace Sarl, a key group in Luxembourg's space industry, and SnT have signed a three-year agreement to cooperate on the development of an innovative and scalable Attitude and Orbit Control System (AOCS) for micro satellites. Several future missions of LuxSpace will require a system to determine the satellite's location and to manoeuvre it using a propulsion system. Those systems are available for standard LEO and GEO satellites but not yet for micro satellites. The group is also investigating using electric and green propulsion systems that are not based on highly toxic hydrazine.

NetLab

Head of research group: Prof. Dr. Thomas Engel

Enhanced network management and security in SDN

Contact: Dr. Maria Rita Palattella

Software Defined Networking (SDN) is a new emerging network paradigm which introduces a centralised and programmable way to design networks. SDN features, combined with cognitive learning algorithms, open new possibilities for operating highly reactive network security monitoring, attack/fault detection and fast mitigation without the need for administrative involvement. The CoSDN team at NetLab is developing new approaches which further build upon the potential gains offered by SDN for performing network troubleshooting and anomaly detection. Some suggested solutions have been implemented in a first prototype in collaboration with industrial partners.

Confidentiality in connected communities for the internet of the future

Contact: Dr. Andriy Panchenko

Community-based WiFi networks are valuable for users who can gain internet access in new locations, but they are not without dangers. When users connect to these networks, they access a domain controlled by a potentially untrustworthy operator. Through the participation in the EU funded project CONFINE, the NetLab team got a possibility to tailor their traffic analysis protection methods to the needs of users in community-based networks. As a result, the NetLab was able to recommend measures that will allow users to surf the internet via such networks without worrying about their privacy.

Projects

Ongoing partnered projects 2014

Project	Principal investigator	PhD student	Partner
Satellite Systems			
Satellite Communication Network for Mobile Users	Prof. Dr. Björn Ottersten	Dimitrios Christopoulos	SES / FNR-CORE
Interference Cancellation and Synchronisation for Next Generation Satellite Broadcasting Waveforms	Prof. Dr. Björn Ottersten	Zohair Abu Shaban	SES / AFR-FNR
Spectrum sensing, Resource re-allocation and Spectrum management strategies for satellite cognitive radio	Prof. Dr. Björn Ottersten	Shree Krishna Sharma	SES / AFR-FNR
Signal Processing for Mitigating Non-linear effects in Satellite Communications	Prof. Dr. Björn Ottersten	Roberto Piazza	SES / AFR-FNR
Transmission and Reception Techniques for Smart Gateways in Next Generation Satellite Systems	Prof. Dr. Björn Ottersten	Ahmad Gharanjik	SES / AFR-FNR
Spectrum Management and Interference Mitigation in Cognitive Hybrid Satellite Networks	Prof. Dr. Björn Ottersten	Anestis Tsakmalis	SES / FNR-CORE
Satellite Sensor Networks for spectrum monitoring	Prof. Dr. Björn Ottersten	Politis Christos	SES
Advanced Signal Processing techniques for satellite communications	Prof. Dr. Björn Ottersten	Mengali Alberto	SES / AFR submitted
Broadband/Broadcast Convergence through Intelligent Caching in 5G Satellite Networks	Prof. Dr. Björn Ottersten	Spano Danilo	SES
Model translation and Model Visualisation	Prof. Dr. Thomas Engel	Susann Gottmann	SES / AFR-FNR
Refactoring and Semantical Correctness	Prof. Dr. Thomas Engel	Nico Nachtigall	SES / AFR-FNR
Securing Mission Operations using Multi-Level Security	Prof. Dr. Thomas Engel	Eleftherios Skoutaris	ESA (NPI)
Model-based Regression Testing Strategies	Prof. Dr. Lionel Briand	Daniel Di Nardo	SES / AFR-FNR
Model-Driven Requirements Engineering to ensure Consistency	Prof. Dr. Lionel Briand	Chetan Arora	SES / AFR-FNR
Planning of Payload Reconfiguration	Prof. Dr. Pascal Bouvry	Apostolos Stathakis	SES / AFR-FNR
Vehicular Networks and Smart Homes			
Multimedia Sensor Networks	Prof. Dr. Thomas Engel	Stefan Hommes	POST / AFR-FNR
Advanced Vehicle Routing in Urban Environments	Prof. Dr. Thomas Engel	Lara Codeca	POST / AFR-FNR
Incentives and Game Design concepts to change driver behavior	Prof. Dr. Thomas Engel	Martin Kracheel	POST / FNR-CORE
Routing and mobility management in vehicular networks	Prof. Dr. Thomas Engel	Maximilien Mouton	POST / FNR-CORE
Security and Management of vehicular networks	Prof. Dr. Thomas Engel	Lautaro Dolberg	POST / FNR-CORE
Mobility optimization using vehicular network technologies	Prof. Dr. Thomas Engel	Markus Forster	POST / FNR-CORE
MODEst: Multimodal OD Estimation	Prof. Dr. Francesco Viti	Simone Di Donna	POST / FNR-CORE
Multimodal Transport Optimisation, Network Mobility	Prof. Dr. Thomas Engel	Thierry Derrmann	POST / FNR-CORE

Project	Principal investigator	PhD student	Partner
Automotive Software and Sensor Systems			
Cost-Effective Automated Test Case Generation in Automotive Embedded Systems	Prof. Dr. Lionel Briand	Reza Matinejad	Delphi / AFR-FNR
Automated Debugging and Fault Localization of Matlab/Simulink Models	Prof. Dr. Lionel Briand	Bing Liu	Delphi / AFR-FNR
Requirements-Based Test Generation for Embedded Systems	Prof. Dr. Lionel Briand	Chunhui Wang	IEE
Automated Model-based Support for Change Impact Analysis in Automotive Software Systems	Prof. Dr. Lionel Briand	Sami Maddouri	Delphi
Automating Regression Test Selection for Requirements-based Testing in Embedded Systems	Prof. Dr. Lionel Briand	Ines Hajri	IEE
Development of an Energy Management System for Electric Vehicles	Prof. Dr. Holger Voos	Tim Schwickart	IEE
Estimating Body Shapes via Intelligent Imaging	Prof. Dr. Björn Ottersten	Girum Getachew Demisse	Cubelux
Super-Resolution for Mono-View Fusion	Prof. Dr. Björn Ottersten	Kassem Al Ismaeil	IEE / FNR-CORE
Multi-View Sensor Fusion	Prof. Dr. Björn Ottersten	Hassan Afzal	IEE / FNR-CORE
Secure and Resilient Infrastructures			
Smart honeypots for tracking fraudulent malware	Prof. Dr. Thomas Engel	Samuel Marchal	CETREL / AFR-FNR
Automated Detection of Security Threats in Web Applications	Prof. Dr. Lionel Briand	Dennis Appelt	CETREL / AFR-FNR
An Effective Automated Testing approach for Detection of XML Injection	Prof. Dr. Lionel Briand	Sadeeq Jan	CETREL / AFR-FNR
Prevention of Fraud by Pattern Detection in Credit Card Transactions	Prof. Dr. Björn Ottersten	Alejandro Correa Bahnsen	CETREL / AFR-FNR
Test Generation and Prioritization for Large-scale Software Product Lines	Prof. Dr. Yves Le Traon	Christopher Henard	CETREL
Streaming Analytics for Security Architectures	Dr. Radu State	Christian Hammerschmidt	NEXUS
Big Data Architectures for converged security	Dr. Radu State	Eric Falk	NEXUS
Trusted Location Services for Managed Community Networks	Prof. Dr. Thomas Engel	Yves Neisius	Telindus / AFR-FNR
Enhancing Security Reputation and Performance of Heterogeneous Networks for Ubiquitous Internet Connectivity Sharing in a Mobile Context	Prof. Dr. Thomas Engel	Walter Bronzi	Telindus
Measuring the security reputation of intermediaries used by mobile devices to connect to wireless networks	Prof. Dr. Thomas Engel	Fabian Lanze	RedDog / AFR-FNR
Smart City / Building / Home			
Modeling, Design and Test for the privacy, security and conviviality for Socio-Technical Systems in Ambient Intelligence	Prof. Dr. Yves Le Traon	Assaad Moawad	VdL / FNR-CORE
Secure and private location proofs/architecture and design for location based services	Prof. Dr. Sjouke Mauw	Chen Xihui	itrust / AFR-FNR
Continuous Development, Deployment, and Testing for Self-adaptive Software Systems; a new engineering process applied to smart home	Prof. Dr. Yves Le Traon	Alejandro Sanchez Guinea	POST

Project	Principal investigator	PhD student	Partner
Reliable and Secure Smart Grid Infrastructures			
Online Identification and Feed-in Fault Detection for Smart Grids	Prof. Dr. Jürgen Sachau	Hrag Margossian	CREOS / FNR-CORE
Optimised Power-Line Usage in Smart Part-Grids with Active Limiting	Prof. Dr. Jürgen Sachau	Ilya Bilibin	CREOS / FNR-CORE
On-line Grid Impedance Measurement of Accommodation of Distributed Generation	Prof. Dr. Jürgen Sachau	Surena Neshvad	CREOS / AFR-FNR
Reactive Cyber security for Smart Grids using a Model-driven Reasoning Engine	Prof. Dr. Yves Le Traon	Thomas Hartmann	CREOS / AFR-FNR
Networked SCADA	Prof. Dr. Thomas Engel		CREOS
Compound Data/Power-Network reliability	Prof. Dr. Jürgen Sachau		CREOS
e-Government			
Model-based Framework for Specifications and Automated Verification of Compliance to the Tax Law	Prof. Dr. Lionel Briand	Ghanem Soltana	CTIE / AFR-FNR
Model-driven run-time verification of eGovernment business processes	Prof. Dr. Lionel Briand	Wei Dou	CTIE
ACROPOLIS – Supporting e-Democracy in Luxembourg	Prof. Dr. Peter Y. A. Ryan		CTIE
Other partnered projects			
Holistic autonomic Energy and thermal aware resource allocation in cloud computing	Prof. Dr. Pascal Bouvry	Mateusz Guzek	Tri-ICT Benelux / AFR-FNR
Challenges facing Cloud Computing. Legal assessment with special consideration of data protection and intellectual property law, including a case study of the banking and financial sector	Prof. Dr. Mark Cole	Alicja Gniewek	BCEE / AFR-FNR
The impact of social media on the leadership strategies of Generation Y (digital natives) – Challenges and potential	Prof. Dr. Charles Max	Florian Feltes	Buhr&Team
Model-driven Run-time Verification of Role-based Access Control Policies	Prof. Dr. Lionel Briand	Ameni Ben Fadhel	HITEC
VICO – Vision-based Control of Small Unmanned Aerial Vehicles	Prof. Dr. Holger Voos	Arun Annaiyan	Ministry of Foreign Affairs of Luxembourg

EU, ESA and EDA projects 2014

Project	Principal investigator	Website or/and Researcher
ACDC – Advanced Cyber Defense Centre	Prof. Dr. Thomas Engel	http://www.acdc-project.eu
BUTLER – uBiquitous, secUre inTernet-of-things with Location and context-awaReness	Prof. Dr. Thomas Engel	http://www.iot-butler.eu
CONFINET – Community Networks Testbed for the Future Internet	Prof. Dr. Thomas Engel	http://www.confine-project.eu
CoRaSat – Cognitive Radio for Satellite Communications	Prof. Dr. Björn Ottersten	http://ict-corasat.eu
ECIAO – EU-China future Internet common Activities and Opportunities	Prof. Dr. Thomas Engel	http://www.euchina-fire.eu
eGlasses – The interactive eyeglasses for mobile, perceptual computing	Prof. Dr. Thomas Engel	http://e-glasses.info/Home.html
FETCH – Future Education and Training in Computing: How to meet our students where they are	Prof. Dr. Thomas Engel	
FREESIC – FREE Secure Interoperable Communications	Prof. Dr. Thomas Engel	http://www.freesic.eu
GEN6 – Governments Enabled with IPv6	Prof. Dr. Thomas Engel	http://www.gen6.eu
IoT6 – Universal Integration of the Internet of Things through an IPv6-Based Service-oriented Architecture enabling heterogeneous components interoperability	Prof. Dr. Thomas Engel	http://www.iot6.eu
LiveCity – Live Video-to-Video Supporting Interactive City Infrastructure	Prof. Dr. Thomas Engel	http://www.livecity-psp.eu
ReDIRNET – Emergency Responder Data Interoperability Network	Prof. Dr. Thomas Engel	http://www.redirnet.eu
SANSA – Shared Access Terrestrial-Satellite Backhaul Network enabled by Smart Antennas	Prof. Dr. Björn Ottersten	
TREsPASS – Towards Risk Estimation by Probabilistic Assessment of Socio-Technical Security	Prof. Dr. Sjouke Mauw Prof. Dr. Peter Y. A. Ryan	http://www.trespass-project.eu
APEXX-CCN – APEXX extension on Fractionally Spaced Equalizer	Prof. Dr. Björn Ottersten	Dr. Bhavani Shankar Mysore Rama Rao
ASPIIM – Antennas and Signal Processing Techniques for Interference Mitigation in Next Generation Ka Band High Throughput Satellites	Dr. Symeon Chatzinotas	
C&C – Catch & Carry	Prof. Dr. Holger Voos	
DVB-Sx – Novel Ground Components Prototype beyond DVB-S2 for Broadband Satellite Networks	Prof. Dr. Björn Ottersten	Dr. Bhavani Shankar Mysore Rama Rao
GBBFT – Future Ground-Based Beam-Forming Techniques	Dr. Symeon Chatzinotas	Dr. Bhavani Shankar Mysore Rama Rao
PreDem – Precoding Demonstrator for broadband system forward links	Prof. Dr. Björn Ottersten	Dr. Symeon Chatzinotas
Space for Med Ambassador Platform in Luxembourg	Dr. Jean Schweitzer	http://artes-apps.esa.int/community-portal/spaceformed
SMO-SLS – Securing Mission Operations using Multi-Level Security	Prof. Dr. Thomas Engel	Dr. Eleftherios Skoutaris
ASIMUT – Aid to Situation Management based on Multimodal, MultiUAVs, Multilevel acquisition Techniques	Prof. Dr. Pascal Bouvry	

Completed EU, ESA and EDA projects

Project	Principal investigator	Website or/and Researcher
APEXX – On-ground multi-carrier digital equalization / pre-distortion techniques for single or multi gateway applications	Prof. Dr. Björn Ottersten	Dr. Bhavani Shankar Mysore Rama Rao
ceFIMS-CONNECT – Coordination of the European Future Internet Forum of Member States and the Collection and Sharing of Research Data to enhance and Promote National Cooperation	Prof. Dr. Thomas Engel	http://www.cefims.eu
IPv6 Deployment Monitoring	Latif Ladid	http://www.ipv6observatory.eu
Web2LLP – Improving web strategies and social media presence of LLP projects	Prof. Dr. Charles Max	http://www.web2llp.eu

Ongoing FNR projects 2014

Project	Principal investigator	Partner	Programme
aToMS – a Theory of Matching Sessions	Prof. Dr. Peter Y. A. Ryan		CORE
ACRYPT – Applied Cryptography	Prof. Dr. Alex Biryukov		CORE
ADT2P – Attack-Defence Trees: Theory Meets Practice (Follow-up ATREES)	Prof. Dr. Sjouke Mauw	SINTEF THALES	CORE
AndroMap – Static Analysis For Android Security: Building the Map of Android Inter-App Communication	Dr. Jacques Klein	Pennsylvania State University, Techn. Universität Darmstadt, University of Lille	CORE
BRAIDS – Boosting Security and Efficiency in Recommender Systems	Dr. Qiang Tang (Junior) Prof. Dr. Peter Y. A. Ryan	University of South Australia, Irdeto	CORE Junior Track
CoPAINS – Conviviality and Privacy in Ambient Intelligence Systems	Prof. Dr. Yves Le Traon	University College London	CORE
COSDN – Cognitive Software Defined Networks	Prof. Dr. Thomas Engel	Warsaw University of Technology	Pollux / NCBR
DYNGBaT – Dynamics of Group Belief	Prof. Dr. Leon Van Der Torre		CORE
ECO-CLOUD – Energy Efficient Communication in Cloud Computing	Dr. Dzimtry Kliazovich	Tri-ICT, University of Sydney	CORE Junior
FAVE – Fusion Approaches for Visual systems Enhancement	Prof. Dr. Björn Ottersten	IEE, Univ. de Bourgogne	CORE
Green@Cloud – Multi-objective metaheuristics for Energy-Aware scheduling in cloud computing systems	Prof. Dr. Pascal Bouvry	Université de Lille	INTER / CNRS
IDSECOM – ID-based Secure Communications system for unified access in IOT	Prof. Dr. Thomas Engel	Warsaw University of Technology, National Institute of Telecommunications	Pollux / NCBR
iGEAR – Incentives and Gaming Environments for Automobile Routing	Prof. Dr. Thomas Engel		CORE
IISD – Strategic RTnD Program on Information Infrastructure Security and Dependability	Prof. Dr. Paulo Verissimo		PEARL
INDOORS – Indoor Navigation with Ambient Radio Signals	Dr. Andrei Popleteev Prof. Dr. Thomas Engel	Microsoft Research	CORE Junior
IRF – Industrial Research Fellow	Prof. Dr. Björn Ottersten		Industrial Research Fellow
IShOP – Internet Shopping Optimization Project	Prof. Dr. Pascal Bouvry	Poznan University of Technology	Pollux / NCBR
LOCALE – Localised Legacies	Prof. Dr. Thomas Engel	LIST (Project coordinator)	CORE

Project	Principal investigator	Partner	Programme
MAMBA Architecture – Multimodal MoBility Assistance	Prof. Dr. Thomas Engel		CORE
MITER – Modeling, Composing and Testing of Security Concerns	Dr. Jacques Klein		CORE
MODEL – MOdel-driven aDaptive usEr-centered service Lines2	Dr. Jacques Klein	LIST, Kitry Consulting, Université de Grenoble, INRISA Rennes, Université Catholique de Louvain la Neuve	CORE
MOVE – Mobility Optimization using VEHicular network technologies	Prof. Dr. Thomas Engel	UCLA	CORE
Rational Architecture – Rational Architecture	Prof. Dr. Leon Van Der Torre	LIST (Project coordinator)	CORE
REDESG – Reliable and Efficient Distributed Electricity Generation in Smart Grids	Prof. Dr. Jürgen Sachau		CORE
SATSENT – SATellite SENSor NeTworks for spectrum monitoring	Dr. Symeon Chatzinotas Prof. Dr. Björn Ottersten	SES	CORE Junior
SeMIGod – SpEctrum Management and Interference GeOlocation in cognitive raDio Satellite networks (Follow-up CO2SAT)	Prof. Dr. Björn Ottersten	SES	CORE
SenseFleet – Sensefleet	Dr. Raphaël Frank		Proof of Concept
SeSaNet – Integrated Security and Safety Engineering for Networked Control Systems	Prof. Dr. Holger Voos	Univ. Henri Poincaré Nancy I, IUT	CORE
SEQUOIA – Security Properties, Process Equivalences, and Automated Verification	Prof. Dr. Peter Y. A. Ryan	INRIA, CNRS, Ecole Nationale Supérieure de Cachan	INTER / ANR
SIEP – Specification logics and inference tools for verification and Enforcement of Policies	Prof. Dr. Leon Van Der Torre	Katholieke Universiteit Leuven	INTER / FWO
STAST – Socio-Technical Analysis of Security and Trust	Prof. Dr. Peter Y. A. Ryan, Prof. Dr. Sjouke Mauw	University of Catania, Royal Holloway University of London, Newcastle University, UCL, Norwegian University of Science and Technology	CORE
TDHCS – Testing and Debugging Highly Configurable Systems	Prof. Dr. Yves Le Traon	University College London	INTER Mobility
TOOM – Testing Orders Of Magnitude	Prof. Dr. Yves Le Traon	Federal University of Parana, University of Nanates, EBRC, iTrust	CORE
VSOC – Virtual Security Operation Center as a Service	Dr. Radu State		Proof of Concept
V&V Lab – Verification and Validation Laboratory	Prof. Dr. Lionel Briand		PEARL

Completed FNR projects

Project	Principal investigator	Partner	Programme
AppTrans – AppTrans	Dr. Benjamin Braatz		Proof of Concept
CO2SAT – COoperative and COgnitive Architecture for SATellite Networks	Prof. Dr. Björn Ottersten	SES	CORE
FNR / ERCIM – Pan Lin	Prof. Dr. Holger Voos		ERCIM Grant
VIVO – Verifiable Internet Voting: Moving Theory into Practice	Prof. Dr. Peter Y.A. Ryan	Bern University of Applied Sciences	INTER / SNF

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